



FLAGGING SALES
WHY GULF ORDERS
BONANZA LOST
THRUST IN DUBAI
SHOW REPORT P12

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halt 737 operations **26**

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FLIGHT

INTERNATIONAL

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17-23 NOVEMBER 2015



FIRST FLIGHT

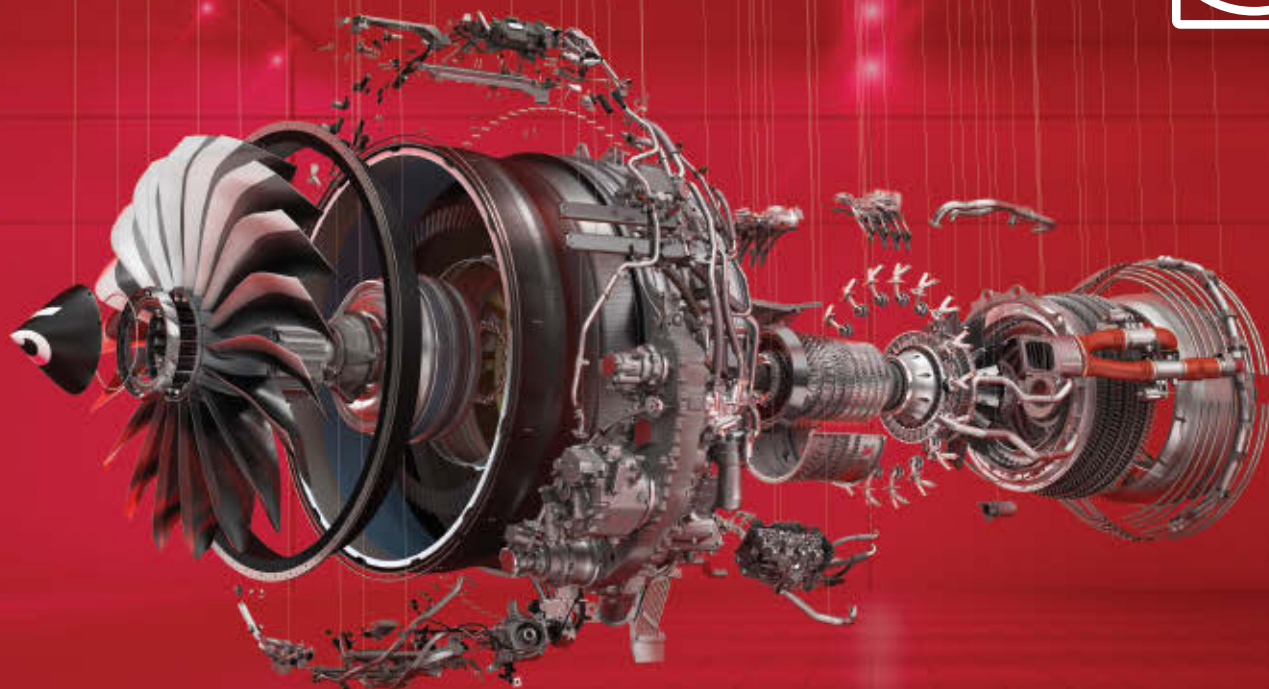
MRJ IS UP AND AWAY

Japan's regional ambitions take off
as Mitsubishi twinjet gets airborne



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LEAP

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COVER IMAGE

Schedule delays were all forgotten on 11 November, when the Mitsubishi Regional Jet took off for the first time. FTA 1 is pictured rising from Nagoya **P30**



BEHIND THE HEADLINES

The Flightglobal team was out in force to bring you the very best coverage from the Dubai air show (**P12**). Also on the road was US test pilot Michael Gerzanics, who was in Brazil to put Embraer's Legacy 450 business jet through its paces (**P42**)



NEXT WEEK AIRLINERS

The first installment of our World Airliner Directory looks at the programmes serving the 100-seat-plus sector

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GAMA data shows rising sales for business jets **P38**

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USMC seeks sales to maintain V-22 production rates **P8**. Saab to supply surveillance Global 6000s to UAE **P7**

IMAGE OF THE WEEK

An Emirates Airbus A380 is flanked by the Jetman Dubai duo of Yves Rossy and Vince Reffet in this pre-air show publicity shot. Using their jet-propelled wings, the pair got in formation at 4,000ft, after being deployed from a hovering helicopter. The Gulf carrier recently took delivery of its 68th superjumbo

View more great aviation shots online and in our weekly tablet edition:



Emirates

THE WEEK IN NUMBERS

↑ **10%**

Flightglobal dashboard

A first-half sales increase, to £339.6m, helped regional carrier Flybe turn last year's £1m loss to a £22.9m profit

€185m

Thales

Contract sealed in Paris will see Thales modernise civil and military air traffic control throughout Bolivian airspace

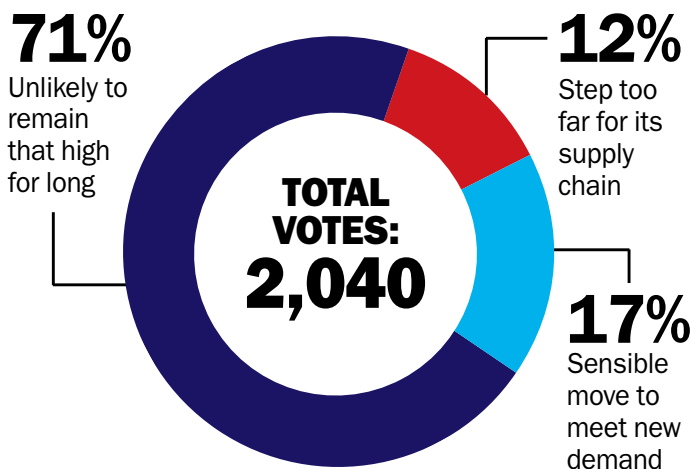
↑ **69**

Arianespace

Number of consecutive Ariane 5 launch successes, with the orbiting of satellites for Saudi Arabian and Indian customers

QUESTION OF THE WEEK

Last week, we asked: **Airbus's decision to boost A320 production to 60 per month is:** You said:



This week, we ask: **The lack of mega-deals at Dubai show is:**

- ☐ Worrying indication of order bubble
- ☐ Natural after 2013's largesse
- ☐ No problem: jetpacks are the future

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The Power of Flight

No Dubai-buy-buy

In terms of commercial aircraft orders, this year's air show was a shadow of its former self, but the region's airlines may simply be between courses, rather than at the end of the meal

As a single-word description, 'excess' normally suits the commercial segment of the Dubai air show. If it's actually possible to do nothing excessively, the term fits again this year.

Four Gulf carriers combined to order more than \$170 billion worth of airliners on the first day of the Dubai air show in 2013. Two years later, the same four airlines – Emirates, Etihad, FlyDubai and Qatar – played transactional hooky from the event.

The only completely new commercial sale of any significance announced was from a Vietnamese carrier, an entity based as far from Dubai as London.

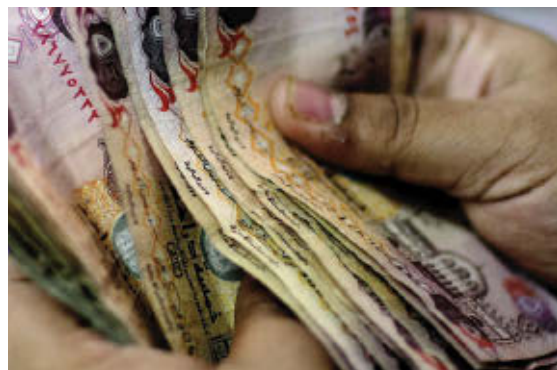
Plenty of narratives could explain why the stream of orders expired this year. Perhaps the region's airline executives should be taken at face value when they say they don't need to order more aircraft at the moment.

Or possibly the absence of Middle East orders could be interpreted as a political gesture. With so much scrutiny on the growth plans of Gulf airlines, particularly in the USA, signing another round of blockbuster deals might be like spraying oil around a hot jet engine.

The only new commercial sale of any significance announced was from a Vietnamese carrier

But there should be little worry about the validity of the third possible narrative. Ever-growing Airbus and Boeing single-aisle production rates again raise fears of an order bubble. But the region's acquisitive abstinence in Dubai does not fit into that profile. Not only are their backlogs robust and secure, no responsible forecast imagines that situation changing in the near future.

The caveat to any such prediction, of course, is the



Saving it for a rainy day?

increasingly complex outbreaks of violence in so many states neighbouring the Gulf. It is that situation that prompted most of the spending at the show.

The United Arab Emirates ordered a future key asset, selecting Saab's Bombardier Global 6000-based airborne early warning platform for a two-aircraft deal.

And the UAE also added to one of the world's most eclectic collections of aircraft development projects.

The country already sponsors unmanned and maritime patrol versions of the Piaggio Avanti II, and operates a cropduster converted into a heavily armed gunship. Now it is also the first committed backer of the AgustaWestland AW609 civil tiltrotor – helping that programme rebound from a recent flight-test tragedy. Oh, and it tentatively ordered personal jetpacks for its emergency services. As you do.

When the time is right, the region's airlines may serve the same purpose for certain commercial programmes, such as the Airbus A380neo. But that time has not yet come. ■

See This Week P7, Show Report P12

Never put off 'til tomorrow...

Procrastination, we are oft-warned, is a Bad Thing. Putting off to tomorrow what could be done today sounds dangerously like sloth – a gift to the early birds and a sure way to store up trouble.

Unless you prefer another aphorism: haste makes waste? Eschewing knee-jerk reactions to sit on one's hands looks wise when dawn breaks on new realities.

Airlines must be wondering where lies virtue. The frantic rush to order vast numbers of new aircraft, rooted in the pre-crisis boom and crisis-leading fuel price shock, sniffs of over-reaction. With oil dripping along at \$50 a barrel and global growth gloopy at best, newer and larger fleets may look like expensive luxuries.

Since those more-contemporary aircraft will always

be out there – and will just keep getting more contemporary – surely it makes sense to, well, procrastinate? After all, a penny saved is a penny earned.

But looming realities should compel investment, if not in new fleets then in other boosts to fuel efficiency.

Fuel will get more expensive as the oil industry adjusts to low prices, and may rise sharply if, say, war spreads in the Middle East. Money is cheap right now, but interest rates will rise. Governments may also move to regulate aviation greenhouse-gas emissions; at next month's Paris climate change summit, something is sure to be said about aviation's growing CO₂ problem.

Help for those who help themselves, so to speak. ■

See This Week P8



To access our full coverage from the Dubai air show and our *Flight Daily News* issues: flightglobal.com/dubai



BRIEFING

PAL GETS FRIENDLY WITH P&W FOR NEO ENGINES

PROPULSION Philippines Airlines (PAL) has signed a memorandum of understanding for Pratt & Whitney PW1100G engines to power an incoming fleet of Airbus A321neos. Flightglobal's Fleets Analyzer database lists PAL as operating 57 aircraft, including 43 A320-family jets. The Philippine flag carrier has 30 A321neos on order. Deliveries are scheduled to begin in 2017.

R-R RESTRUCTURES ON BACK OF 2016 OUTLOOK

FINANCES Engine manufacturer Rolls-Royce is to undertake a further restructuring initiative after a review, and says its business is to face greater financial pressure next year than previously expected. The review doubles the impact on its 2016 profit outlook to £650 million (\$990 million), from an earlier figure of £300 million. R-R says it aims to save £150-200 million annually from 2017 through a wide-ranging cost-reduction programme.

NEW ENTITY FILLS VOID LEFT BY DEFUNCT ESTONIAN

AIRLINES A new company established by the Tallinn government in September to ensure flight links to the country continue in the event of the collapse of Estonian Air has begun operations. It follows the carrier's ceasing operations on 8 November in the wake of a European Commission ruling that it needed to pay back more than €85 million (\$91 million) in illegal state aid. Flights are now being operated on behalf of the new entity, Nordic Aviation Group, by a number of airlines, including BMI Regional and Carpatair.

EUROPE LOOKS TO TACKLE 'UNFAIR' SUBSIDIES

REGULATION Members of the European Parliament are seeking to reinforce protection against competition from subsidised third-country airlines as part of a broader package of aviation measures. The parliament has adopted a resolution calling for the European Commission to revise current rules to tackle "unfair practices that distort the market", including subsidies and state aid to non-European carriers. Members passed the resolution on 11 November.

METROJET EXPLOSION THEORY GAINS MOMENTUM

SAFETY Egyptian accident investigators have confirmed that a noise can be heard in the last second of the cockpit voice recording from the MetroJet Airbus A321 that crashed over Sinai on 31 October. However, they also say that more analysis is needed to identify it. The Egyptian Accident Investigation Committee insists no cause has been determined, and says spectral analysis is to be performed.

TO THE MOON OR MARS, VIA ITALY AND OHIO

SPACEFLIGHT NASA's bid to return astronauts to deep space for the first time since the last Apollo mission took a key step, with the delivery to Ohio, for launch stress-testing, of a test version of the European Space Agency-supplied service module, built in Turin by Thales Alenia Space, for the in-development Orion crew capsule. The two units – to carry up to six astronauts to low-Earth orbit, or four to the Moon or beyond – are being readied for an uncrewed test flight in 2018, atop NASA's in-development SLS rocket.

SIKORSKY: A LOCKHEED MARTIN COMPANY

INDUSTRY Lockheed Martin has finalised its acquisition of Sikorsky, with the latter having appeared under new branding for the first time at the Dubai air show. The rotorcraft manufacturer will now be fully integrated under the leadership of company president Dan Schultz.



Testing was completed using instrumented production aircraft IPA2

WEAPONS CRAIG HOYLE DUBAI

Storm Shadow in Typhoon release

Eurofighter consortium demonstrates missile integration, as UK team targets operational readiness after mid-2017

MBDAs Storm Shadow cruise missile has for the first time been released from a Eurofighter Typhoon, as part of an extensive capability update.

Conducted over the Aberporth test range in the UK on 6 November, the milestone event involved releasing the precision-strike weapon from beneath the wing of Alenia Aermacchi's instrumented production aircraft IPA2.

"The integration of the missile with the aircraft's weapon system was successfully demonstrated," the Eurofighter consortium says. "The trials also verified the interface of the missile with the weapon system for pre-launch checks, demonstrated post-launch safe separation and the subsequent commencement of missile flight."

More than 5m (16.4ft) in length and weighing 1,300kg (2,860lb), the Storm Shadow has a range of more than 135nm (250km).

Integration of the new Typhoon weapon forms part of an ongoing programme of enhancements for the European type, along with MBDA's Meteor beyond-visual-range air-to-air missile and Brimstone 2 air-to-surface missile.

Referring to the ongoing test programme, Sqn Ldr Alex Tennant from the UK's Typhoon combined test team says Storm

Shadow should be available for use following the delivery of approved P2E-standard software around the middle of 2017.

Separately, a ground trial has proved the feasibility of the twin-engined type carrying six MBDA Marte ER anti-ship missiles.

Meanwhile, Alenia Aermacchi chief executive Filippo Bagnato has provided a brief update on the status of contract discussions between the Italian and Kuwaiti governments about the latter's planned acquisition of 28 Typhoons. A deal is expected to be signed "shortly – very shortly", he says.

BAE Systems, which holds the UK's interest in the Eurofighter consortium, said in a 12 November trading update that subject to the contract being concluded, Typhoon deliveries to Kuwait would begin "around the end of the decade", indicating that production would continue into the 2020s.

That deal is still being contested by US manufacturer Boeing, which hopes to sell its F/A-18E/F Super Hornet to the Gulf nation, which already operates 34 older F/A-18C/D-model Hornets.

However, Boeing officials expressed concern that a sluggish approvals process in Washington will cement Kuwait's defection to the European manufacturer. ■



USMC seeks export buyers to sustain Osprey build rate
THIS WEEK P8

THIS WEEK

ORDERS DAVID KAMINSKI-MORROW DUBAI

A330neo sales lull was intentional, says Leahy

Airbus insists the absence of orders for the re-engined A330neo is due to a deliberate strategy aimed at preventing cannibalisation of the current A330 line.

But the airframer indicates that it expects a further order for the type by the end of this year, and additional activity next year, after restarting the dormant sales effort.

Chief operating officer for customers John Leahy says the A330neo's quiet period has been "intentional".

"I would not authorise [sales] for the last year, or year-and-a-half, because we had the [current A330]



Airframer expects next contract for re-engined type later this year

to sell," he told *Flight International* at the Dubai air show.

He says the airframer has been concentrating on ensuring sufficient A330 backlog to

bridge the transition gap to the re-engined type.

Airbus has already been forced to cut the monthly production rate of the A330 to six

from the first quarter of 2016.

But Leahy says that a Chinese agreement for up to 75 A330s, plus a Saudia deal for 20 and firmed options on several others from IAG, have helped to strengthen the backlog.

Airbus booked net orders for 92 current A330s over the first 10 months of the year, an achievement which stands to give the company its best full-year sales figures for the type since 2008.

This year has been "strong" for the A330, says Leahy, adding Airbus's confidence in the line means it effectively returned to selling the A330neo during September. ■

DEVELOPMENT CRAIG HOYLE DUBAI

UAE's surveillance aircraft contract is surprise opener

Saab signs Dubai air show deal to supply pair of heavily-modified Global 6000s to air force

While all the talk in the run-up to the Dubai air show was about the prospect of large commercial orders being announced, it was the United Arab Emirates air force that opened sales, with a surprise, \$1.27 billion contract with Saab for advanced surveillance aircraft.

Announced on 9 November, the agreement covers the provision of two Bombardier Global 6000 business jets, following their extensive modification by the Swedish company.

"I am extremely happy to announce the first deal that has been signed," Maj Gen Abdulla Al Sayed Al Hashemi of the UAE defence ministry said, flanked by Saab chief executive Håkan Buskhe.

Saab will equip the platforms with an evolution of its Erieye airborne surveillance radar, and also integrate a ground surveillance radar payload and electro-optical/infrared sensor. These will combine to provide a "swing-role" capability also en-

compassing maritime surveillance, says Micael Johansson, head of Saab's Electronic Defence Systems business unit.

"We are very happy to continue our relationship with Saab," says Al Hashemi, adding that the air force's current two airborne early warning-ruled Saab 340 turboprops will also be upgraded under the arrangement.

"We have been here for a couple of years with a very skilled partner, and have contributed to many of the new ideas of utilising airborne early warning systems," Buskhe says. "The new version of the Erieye and the swing-role system is a game changer in surveillance capability."

The new suite of sensors for the swing-role surveillance system has been tested, but a delivery schedule has yet to be finalised between the partners. The UAE order represents the first AEW application for the Global 6000 platform, which already is used in a special mission role for the US Air Force. ■

See Show Report P12



Long-range type will scan for airborne, land and maritime threats



FLIGHT DAILY NEWS
FULL COVERAGE

Dubai air show visitors were able to pick up four issues of *Flight Daily News*, packed with the best reporting and images. To access these and additional content, visit our landing page:

flightglobal.com/dubai

FORECAST DAN THISDELL LONDON

Aviation growth will out-pace emission goals

Oil demand for aviation is set to grow faster than for any other sector through 2040, leaving no hope for the industry to achieve its goal of carbon-neutral growth after 2020 without offsets from other sectors, the International Energy Agency (IEA) has warned.

The problem, says the agency, is that improvements in aircraft fuel efficiency cannot counter emissions from increasing air traffic without access to far greater volumes of advanced biofuel than can be produced.

Improvements in aircraft fuel efficiency cannot counter emissions from air traffic

INTERNATIONAL ENERGY AGENCY

This forecast from the IEA in its World Energy Outlook report, covering the period to 2040, is based on conservative growth assumptions. The agency expects global revenue passenger-kilometres (RPKs) to rise at a rate of 3.9% a year, to more than 16 trillion in 2040. That is comparable with IATA's assumption of 4.1% growth but short of the 5.5% expected by Airbus, Boeing and ICAO.

The IEA's expectations of aircraft fuel-efficiency improvement are broadly in line with the aspirational ICAO target of 2% improvement globally from 2021 to 2050. But while total aviation fuel demand has been rising by only a third as fast as RPKs over the past 15 years – owing in part to the advent of more fuel-efficient aircraft with more seats – it is to grow at half the rate of RPKs in the years to 2040, eventually reaching nine million barrels a day.

More broadly, the IEA expects that crude oil supply and demand will balance to push prices up to \$80 per barrel in 2020, up from around \$50 today. ■

ROTORCRAFT JAMES DREW DUBAI

USMC seeks export buyers to sustain Osprey build rate

Production slowdown predicted for V-22 tiltrotor if additional customers are not secured

The US Marine Corps desperately wants the Bell Boeing V-22 Osprey to secure further export orders to mitigate a production slowdown expected between 2017 and 2020.

Although the USMC will place its third multi-year order for the Osprey in 2017, there are relatively few aircraft still to be produced for the marines and US Air Force from a combined 379-unit order before the next variant appears towards the end of the decade.

The HV-22s to be acquired by the US Navy as a replacement for its Grumman C-2A Greyhound fleet for the carrier onboard delivery mission, will not start being procured until the 2018 fiscal year for delivery in 2020, says V-22 joint programme manager Col Dan Robinson.

The navy's requirement is for 48 examples of a modified, longer-range version, which it hopes will attain initial operational capability in FY2021. That will keep production at a minimum level through about 2019 or 2020 as the final marine MV-22s and air force CV-22s are delivered.



US Marine Corps

Final deliveries from a 379-unit order are expected during 2020

If more near-term customers – either the USA or allies – come on board, the unit price could fall by 10%, the navy believes.

"I'd welcome additional customers, whether domestic or international," Robinson said at the Dubai air show, where the US military had a pair of MV-22s in the static display.

Robinson sees the potential for several new customers to come

on board by June 2016, when negotiations must start to be translated into firm orders to avoid the production slowdown.

"There are several countries that have requested briefings and others who've asked for pricing and availability," he says. "There's probably more that have expressed interest in V-22, but three or four are well beyond that." ■

PROGRAMME

MRJ debut propels sales campaign

The Mitsubishi Regional Jet took to the skies for the first time on 11 November, with lead prototype FTA 1 completing an 87min sortie from Nagoya

airport. This included taking the aircraft to 15,000ft and 150kt (277km/h).

A rival to the in-development Embraer E-Jet E2 family, the Japa-



Mitsubishi Aircraft

Aircraft FTA 1 completed an 87min sortie, reaching up to 150kt

nese company's family of aircraft will enter use from the second quarter of 2017, led by the MRJ90 model now entering a 2,500h flight-test campaign. First parts for a smaller MRJ70 variant are already being produced, but the company has yet to commit to a proposed 100-seat development.

Current orders for the MRJ total 223 firm commitments from six customers in Asia and the USA, plus options on a further 184. Mitsubishi Aircraft hopes to soon add to this, citing interest from other carriers in Asia and Europe. ■

See Cover Story P30

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NARROWBODIES DAVID KAMINSKI-MORROW DUBAI

Lessor places first CS300s

Ilyushin Finance chief closing on agreement to supply two CSeries jets to non-Russian airline

Russian lessor Ilyushin Finance has tentatively agreed its first Bombardier CSeries placement, with a deal for two aircraft from a non-Russian carrier.

The lessor, which has agreed to acquire 32 CS300s, has been intending to market the type to foreign operators – a strategy which has become more crucial following the problems in the internal Russian air transport market.

Speaking to *Flight International* at the Dubai air show, Ilyushin Finance chief executive Alexander Rubtsov said the two CS300s would be delivered at the end of 2016 if the agreement is approved.

He declines to identify the customer, but confirms that the deal is the first it has reached for placement of the CSeries. Rubtsov adds that the lessor has also signed a letter of intent to place up to 10 Sukhoi Superjet 100s with an undisclosed non-Russian operator. There is a December deadline, he says, to finalise the agreement,



Deliveries will take place in 2016 if pending order is approved

comprising five firm and five optioned 100-seat aircraft.

Ilyushin Finance has agreed to take 20 Superjets and Rubtsov says a further six could be placed with another non-Russian carrier.

Securing clients outside of Russia is particularly important, Rubtsov says. “Over-capacity is a pretty humungous problem for existing customers,” he says.

Ilyushin Finance is having to relocate five Transaero aircraft – two Tupolev Tu-204 freighters and three Tu-214s – following the carrier’s collapse, but Rubtsov

says the freighters were snapped up “surprisingly” quickly.

He says the company has escaped the worst immediate effects of Transaero’s collapse. But Transaero had been a future customer for the Irkut MC-21 and Ilyushin Finance had agreed to place six of the new single-aisle twinjets with the carrier.

Rubtsov says, however, that the lessor is not taking delivery of its MC-21s – of which it has 50 on order – until 2019, adding: “We still have time to work with the market.” ■

SALES STEPHEN TRIMBLE DUBAI

SSJ100 set to arrive at CityJet in March 2016

Irish regional airline CityJet plans to take delivery of its first 98-seat Sukhoi Superjet in March 2016, and a retrofitable winglet upgrade will be available by the end of 2017 as part of the sales agreement.

SuperJet International (SJI), the Alenia Aermacchi-Sukhoi joint venture responsible for marketing the regional airliner in Western markets, confirmed the timetable and contractual arrangement at the Dubai air show.

The CityJet commitment, for 15 firm SSJ100s plus 10 options, was disclosed last month and has redoubled sales efforts around the world. Mexican carrier Interjet’s 19th Superjet was parked in the static display at the show.

SJI is continuing to finalise the sales contract with CityJet. The deal is set to involve a still-undisclosed lessor that would provide the Superjets to CityJet.

“It was a quite tough competition. We competed with Embraer and Bombardier. In the end, they selected the Superjet 100,” says SJI chief executive Nazario Cauceglia.

Among the terms in CityJet’s agreement is a commitment by SJI to deliver a retrofitable winglet upgrade by the end of 2017, he says.

The fuel-saving wing-tip modification is one of several efficiency improvements planned by Sukhoi, Cauceglia adds. A team of engineers is also considering aerodynamic tweaks and weight reductions to improve fuel efficiency, he says. ■

AGREEMENT

MRO pact underpins MC-21 purchase

Egyptian carrier Cairo Aviation has tentatively signed for up to 10 Irkut MC-21s as part of a maintenance co-operation pact on the programme.

Cairo Aviation affiliate KATO Investment is to co-operate on the twinjet project, under an agreement disclosed during the Dubai air show.

KATO and Irkut will look into setting up a regional maintenance centre for the aircraft near El

Alamein airport, some 200km north-west of the Egyptian capital.

As part of the agreement, says Irkut, Cairo Aviation will acquire six MC-21s, and the deal “envisages” an option for four more.

The carrier already has experience operating Tupolev Tu-204s.

Private investment firm KATO plans to “voluntarily render” a region next to the airport on which the proposed MC-21 servicing facilities can be established. ■



Cairo Aviation has signed for Irkut’s developmental twinjet

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Defence sector
buys big at Dubai
air show
SHOW REPORT P12

THIS WEEK

TRAINING CRAIG HOYLE LONDON

Modular pilot courses to cut expense

Wings Alliance launches initiative providing commercial flying instruction on “pay as you go” basis at centres around the UK

A new training system initiative launched in the UK is offering prospective commercial pilots a route to the cockpit at around half the cost of the integrated courses created for major airlines.

Being established by partners including Bristol Groundschool, Cardiff Aviation and several other approved training organisations, the Wings Alliance was formally launched in London on 7 November, at the Heathrow Flight Training exhibition.

The initiative is based on provision of connected modular training at a choice of facilities around the UK, with trainees able to conduct individual phases while holding down a regular job.

“Young pilots currently coming into the industry really only per-

ceive one path through,” says Bristol Groundschool managing director – and Wings Alliance chairman – Alex Whittingham, referring to the attraction of major providers, which prepare students for carriers including EasyJet and Flybe via integrated courses.

AIRLINE EMPLOYMENT

Whittingham describes the new system as a not-for-profit trade alliance to “offer prospective pilots a quality-assured route to airline employment”.

In the UK, other pre-launch supporters include Airways Flight Training of Exeter, Multi-flight, Stapleford Flight Centre and Tayside Aviation, with Ultimate High to provide upset-recovery training. Other backers include individual representative

companies in France, Greece, Jordan, the Netherlands and Poland.

The Wings Alliance is also backed by Scottish operator Loganair. Whittingham adds that the initiative is attracting the interest of other airlines who regularly see their younger pilots leave in pursuit of what he describes as a perceived *Catch Me If You Can* lifestyle at the major carriers.

Student pilots using the new system will typically take between two and four years to complete their training, and Whittingham expects the total cost to range between around £45,000 (\$69,400) and £65,000, with the ability to “pay as you go”. This can compare with up to £120,000 at an integrated provider.

“This is another route, with lower costs and greater maturity

for the students, who are not led by the nose,” says Whittingham.

Cardiff Aviation chairman Bruce Dickinson is a strong advocate of modular training, having used it when he pursued an interest in aviation during his thirties.

FULL-FLIGHT SIMULATOR

“Flight training in Europe is frankly overpriced,” argues Dickinson. “This is something that the industry has been quietly screaming for.”

Dickinson – who is now a training captain on the Boeing 737-400 and has past experience including the 757 – says trainees will complete their instruction with 40h on Cardiff Aviation’s 747-400 full-flight simulator, at which point they will receive a pass or fail rating. ■



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DUBAI 2015

It was always going to be difficult to follow the blockbuster orders of two years ago, and the 2015 edition of the Dubai air show paled – in terms of big commercial aircraft commitments – in comparison with its predecessor.

In fact, it took until the second day for either of the big two airframers to unveil anything of note, and even then, that was an order already logged in Boeing's backlog. Showgoers had to wait a further 24h before Airbus sealed a deal. Despite this, the show was as big and bustling as ever. The static park was full of both civil and military aircraft, notably bolstered by a substantial US presence.

It was the defence sector that had the most to say at Dubai, with multi-billion dollar commitments for new aircraft and manufacturers jostling for a slice of the region's growing spending, particularly for intelligence, surveillance, and command and control assets. Show report by Aaron Chong, James Drew, Michael Gubisch, Craig Hoyle, David Kaminski-Morrow, Murdo Morrison, Niall O'Keeffe, Dominic Perry, Stephen Trimble and Greg Waldron. Pictures by BillyPix



ROTORCRAFT

UAE's surprise launch deal lifts long-troubled AW609

Defence ministry says AgustaWestland tiltrotor will significantly improve SAR capabilities

AgustaWestland scored a major breakthrough for its troubled AW609 programme, with a tentative order from the United Arab Emirates Joint Aviation Command (JAC) for three of the developmental tiltrotors, plus three options.

To be configured for search and rescue missions, the JAC will become the launch customer and help shape its configuration.

The deal came days after a fatal crash in northern Italy of a prototype AW609, which left two test pilots dead and raised questions about the programme.

Explaining its selection of the tiltrotor, Maj Gen Abdulla Al Sayed Al Hashemi of the UAE defence ministry said it would significantly improve the service's SAR capability.

"It gives us the flexibility of rotary and fixed-wing aircraft," he says, citing its 275kt (509km/h) speed and 750nm (1,390km) range – faster and further than conventional helicopters. It al-



UAE military chiefs joined Romiti to announce the commitment

ready uses 11 AW139 intermediate twins for SAR missions.

The deal is yet to be formally concluded, but the partners will work to finalise it "in the short future", says Al Hashemi.

Deliveries of the JAC's aircraft are set to begin around 2019.

Daniele Romiti, chief executive of AgustaWestland, says the agreement shows there is "major trust" in the Pratt & Whitney Canada PT6-powered tiltrotor.

"We are not celebrating too

much because it is too close to what happened, but we have a responsibility to overcome the situation," he says.

The programme has been under a cloud since the 30 October fatal crash involving the airframer's second AW609 prototype (N609AG).

At an earlier show briefing Romiti declined to comment on the accident investigation, but reaffirmed the company's commitment to the tiltrotor. ■

COMBAT AIRCRAFT

AVIC opens up over Gyr Falcon

Chinese airframer AVIC delivered a shock at Dubai by revealing a surprising level of detail about its proposed FC-31 Gyr Falcon fifth-generation multi-role fighter, even though the type has yet to secure a customer.

The aircraft promoted appears to be a follow-on of the company's J-31, a mysterious black fighter that participated in the flying display at Airshow China in Zhuhai last November. The J-31 had its first flight in 2012, but virtually no details have been released.

In a Dubai press briefing, Gyr Falcon designer Lin Peng said the FC-31 is envisaged as a low-observable jet with "multi-spectrum, low-observability characteristics."

No details were given about the FC-31's engines, sensor suite or weapons, however.

The aircraft has six external hardpoints, with an internal weapons bay that can carry a further four munitions. Payload is 8,000kg (17,600lb), of which 2,000kg can be carried internally. Combat radius with internal weapons is 648nm (1,200km), and maximum take-off weight is 25,000kg (55,000lb). ■



WIDEBODY

Al Baker criticises A350's reliability

Qatar Airways chief deepens Toulouse's misery by praising "game-changing" 787 as he takes delivery of 25th aircraft

Qatar Airways had both its latest widebody twinjets – the Airbus A350 and Boeing 787-8 – at the Dubai air show, but comments from the carrier's combative boss indicate their reliability records are heading in different directions. Akbar Al Baker, Qatar Airways chief executive, says he has seen a decline in the dispatch reliability of the A350-900 since the type's flawless introduction.

When the A350-900 began rev-

enue service for launch customer Qatar in January, the aircraft's reliability was "perfect", says Al Baker. However, Airbus has been unable to maintain that standard, he indicates. "We started to get teething problems recently, and Airbus is robustly handling those," says Al Baker, who declines to give details of the A350's technical performance.

Talking to *Flight International*, the Qatar chief pointed to prob-



Qatar Airways began operating the new Airbus twinjet in January

lems with parts availability. "As it is a new programme, they also have issues with the supply chain," he says. Airbus declines to respond to the comments.

For Boeing, Al Baker had compliments. He declared the 787 a "game changer" as the carrier took delivery of its 25th in a show ceremony. "Being the second-

largest operator of 787s, we are delighted with the performance of this aircraft," says Al Baker.

Qatar's chief has in the past aired grievances about the Dreamliner's delays but at the ceremony, Al Baker and Boeing Commercial Airplanes chief executive Ray Conner both spoke of their warm relationship. ■

BUDGET CARRIER

VietJet packs them in with show's only new order

In contrast to the blockbuster deal for \$23 billion-worth of Airbus A380s at the last Dubai show, the airframer's sole commercial order at the 2015 edition was struck with Vietnamese budget carrier VietJet Air on day three.

VietJet has become the first operator to commit to the 240-seat

configuration developed by Airbus for the A321neo.

The airline is taking 21 A321neos as part of an agreement for 30 more Airbus single-aisles. The deal includes nine A321s. VietJet chief executive Nguyen Thi Phuong Thao says while the airline's A321s will have 230 seats, it

will put 240 in the A321neos. Airbus has developed a high-density option for the type which increases capacity beyond the previously approved limit of 220 seats.

VietJet's partner for the current A321s is CFM International, but the carrier has not given a powerplant selection for the re-engined

jets. The airline plans to take delivery of the 30 aircraft from late 2016 to 2020.

With the backlog for the current generation and re-engined narrowbody families continuing to grow, Airbus is not ruling out the possibility that it will still be producing A320neos in 2019. ■

ELECTRONIC WARFARE

Jamming pod will take Italians into hostile territory

Elettronica says anti-threat technology could be applied to air force's Tornados and possibly later to Eurofighter fleet

Italy's air force seems set to join an elite group of services capable of fighting into hostile territory using combat aircraft carrying active jamming technology.

Elettronica chief executive Enzo Benigni welcomed Italian defence minister Roberta Pinotti to the company's stand on the opening day of the show, before announcing a teaming agreement has been signed to work on an escort jammer pod.

Dubbed the ELT/568 and containing proven solid-state transmitters and receivers and active phased array antennas, the pod-based system will be employed for the "interception and effective jamming of a wide field of complex radar threats", the Italian company says. Its agreement with the air force is the result of a need to enhance electronic warfare capabilities in the face of an increased ground-based threat.

"This is a strategic system for combat aircraft, able to cope with modern operational airborne re-

quirements," Benigni says. The first expected application will be with Italy's Panavia Tornado force, but chief marketing and strategy officer Eugenio Santagata says the system could also subsequently be integrated with its Eurofighter fleet.

While the company declines to reveal the status of the project, it confirms the new product has yet to be flown in podded form. However, Santagata notes an operational system could be available "shortly". Design work is ongoing, but the full system is expected to be housed within a pod measuring between 4m (13.1ft) and 6m in length and carried on a combat aircraft's centre-line stores station. Elettronica is aiming to produce a common system for multiple platforms, also including legacy combat aircraft flown by other nations.

The pod will support missions which can currently be performed only using a dedicated electronic-attack asset. ■



Saudi Arabia could acquire up to 23 C130Js on top of tankers

TRANSPORTS

Lockheed confident on C-130J's Gulf prospects

Lockheed Martin is remaining upbeat about the potential for further C-130J sales in the Gulf region, and is pleased with progress on the type's civilian variant, the LM-100J.

Timothy German, international business development manager for the Middle East, says that the company is still in communication with Saudi Arabia about a deal for up to 23 C-130Js, in addition to its existing order for two KC-130J tankers. "Saudi Arabia operates legacy C-130s," notes German. "The opportunity is there for us to help them recapitalise their fleet and expand their missions with new aircraft."

German is also hopeful that the

United Arab Emirates' interest in the purchase of 12 J-model Hercules can be rekindled following the nation's suspension of the acquisition process in 2011.

"We continue to discuss their requirement for C-130Js," says German.

Thomas Wetherall, director of business development for the civil variant, says the first LM-100J has been jig-loaded, and will roll off the production line in early 2017, with its first customer delivery scheduled for early 2018. He declines to identify the operator, however.

US Federal Aviation Administration certification is anticipated next year. ■

CERTIFICATION

Bombardier under pressure on CSeries schedule

Bombardier's campaign to achieve airworthiness certification for the CS100 by year-end will be under heavy schedule pressure, new details of the CSeries test programme indicate.

The airframer disclosed during the show that function and reliability (FNR) testing of the CS100 had started on 7 November with a four-leg flight that began and ended in Mirabel, Quebec.

Stops during the multi-hour trip included the Canadian cities of Moncton, New Brunswick; Halifax, Nova Scotia; and St



The CS100 was at the show in launch customer Swiss's colours

John's in Newfoundland.

However, FNR testing, which validates the aircraft's airworthiness in normal operations, can

sometimes require hundreds of flight hours. Bombardier plans to complete FNR flights between about 15 city pairs in Canada, 20

in the USA, and more in Europe.

Meanwhile, certification flight tests are "close to 100% complete", the airframer says.

The Canadian manufacturer insists the programme is still on track to have the aircraft Transport Canada-certificated by year-end, ahead of service entry with Swiss next year.

Bombardier confirmed at the show its intent to stick with a dual-sourcing strategy for the manufacture of CSeries centre fuselages by China's Shenyang Aircraft and Aernnova in Spain. ■

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TRAINERS

BAE keeps Hawk in picture with a big screen premiere

Large-area cockpit display would better prepare student pilots for advanced combat aircraft

BAE Systems has revealed a cockpit demonstrator of its Hawk trainer with a future configuration featuring a single, large-area display (LAD) for the pilot. Already the subject of extensive development work by the UK company, the LAD would help to better prepare student pilots for operating advanced combat aircraft like the Eurofighter Typhoon and Lockheed Martin F-35.

Sharing the single display philosophy of the latter, the advance would enable a new pilot to view a range of information from multiple sensors, plus a moving map, in advance of flying the more sophisticated – and expensive – types.

But the cockpit enhancement is also an element of another BAE



Current model also could carry precision-guided weapons

activity – that of preparing the Hawk for deployment as a light-strike asset.

Also on display within the company's static line exhibit area, the combat development is depicted with seven stores stations. These could carry a combination of air-to-air missiles, precision-guided bombs and rockets, air-to-surface missiles like MBDA's Brimstone, and also a

centreline pylon-mounted laser designation pod.

BAE says demand exists from nations interested in fielding an affordable strike capability, and also from those considering the acquisition of a so-called companion type for use below their advanced fighters.

The main exhibit at BAE's display was a Hawk T2 from the UK Royal Air Force's 4 Sqn. ■

NARROWBODIES

Boeing unveils Jet Airways as Max customer

This year's show brought forth no 2013-style Boeing 777X orders bonanza, but on day two the silence was broken by the unveiling of Jet Airways as the customer behind a previously unattributed order for Boeing 737 Max 8s.

Boeing says the deal with India's Jet, announced at the show, is for conversions of 25 Next-Generation 737s to the re-engined variants plus options and purchase rights for an additional 50 Max 8s.

Jet will be the first Indian airline to take delivery of a 737 Max, Boeing confirms. Naresh Goyal, Jet's chairman, says: "We do not take our competition lightly and we will further seek to grow the domestic aviation market [in India]." Abu Dhabi's Etihad Airways holds a 24% stake in Jet.

Flightglobal's Fleets Analyzer database shows that the Indian airline's in-service fleet comprises 74 737s, eight Airbus A330s, four 777s and 18 ATR 72s. Jet has 10 Boeing 787-9s and five more A330s on order.

Meanwhile, Boeing has confirmed that it has formally dropped the 'X' suffix from its individual stretched and re-engined 777 variants. ■

BAE says demand exists from nations interested in fielding a companion type for use below their advanced fighters

ROTORCRAFT

H160 gains momentum as flight envelope grows



Never-exceed speed of 180kt should be attainable, says Terral

Airbus Helicopters has taken its in-development H160 twin-engine helicopter to a speed of 176kt (325km/h) during flight tests, and believes a never-exceed speed (Vne) of 180kt should be achievable.

Disclosing the flight-test progress at a Dubai media briefing at its H160 mock-up on the static display, Benoit Terral, sales promotion manager for the type, said the velocity was achieved during a slight descent. Nonetheless, he is confident Vne "could be just after this limit". Maximum cruise

speed of the 5.5-6t helicopter is targeted for 160kt.

Terral says the company has accumulated 60h of test flights since the H160's maiden sortie in June. This has been achieved using the initial flight-test prototype, which is fitted with the Pratt & Whitney Canada PW210 engines that will not be used on production aircraft.

Instead, Turbomeca will supply its new 1,100-1,300shp (820-969kW) Arrano turboshaft which has already been installed on a second H160 prototype due to fly before year-end. ■



USA and UK
targets for Textron,
Thales Fury
SHOW REPORT P18

DUBAI 2015
SHOW REPORT

DEVELOPMENT

Leahy cautious on A350-1000 stretch

Airframer is talking to a number of potential customers on the proposal to gauge market demand, but is not yet convinced

Airbus is studying the potential market for a larger version of the A350-1000 – but not, the airframer insists, as a competitive response to the Boeing 777X.

“This is not going to be a ‘me too’ airplane,” says chief operating officer for customers John Leahy.

Leahy says Airbus has been talking to a “handful” of potential customers to explore whether there is a sufficient market for an aircraft with 50-60 more

seats than the -1000.

He argues that Boeing has pursued the rival 777X simply to cut seat-mile cost figures, and Airbus wants to avoid proceeding with a further A350 development without a clear indication that there is market demand.

While Airbus is “very carefully” looking at a stretched -1000, he says, the airframer still believes the “sweet spot” in the market is the sector occupied by the 777-300ER, and a “large percentage” of that mar-

ket will fall within the -1000’s capability.

The potential stretch would probably require modification of the wing – although not the undercarriage – and Leahy indicates Airbus is discussing the options for a powerplant with Rolls-Royce, which provides the Trent XWB-97 for the -1000.

Flight testing of the XWB-97 engine commenced this month.

Leahy would not be drawn further on the discussions, and whether Rolls-Royce could

squeeze further performance from the XWB-97, acknowledging only that “maybe” a different engine would be necessary – without elaborating on the nature of any change.

“We think we could come up with a very good airplane,” he says, adding – in comparison with the 777X – it would be “essentially clean-sheet”. Airbus has secured orders for 175 A350-1000s following the conversion in October of six -900s by an undisclosed customer. ■

WIDEBODY

Airbus still has faith in superjumbo – despite slow sales and backlog weakness

Despite slower-than-desired activity and an absence of sales for the A380 so far in 2015, Airbus has underlined its faith in the superjumbo. Chief salesman John Leahy insists that the “case for the A380 is inevitable”.

He is confident that the type is becoming “known in the marketplace” and that a new customer could emerge by the end of the year.

Airbus is trying to secure orders for close to 30 A380s per year, to maintain production break-even, but the company is being pressured by the lack of demand and uncertainty surrounding current



Emirates showed its newest A380, which is fitted with 615 seats

customers – with collapsed Russian carrier Transaero, which had orders for four, the latest to weaken the backlog.

“I wish we had more sales sooner,” Leahy admits. “It takes more time to sell an A380 than an A320.”

The A380 backlog stood at 144 aircraft at the end of October, over half of which were due for delivery to Emirates.

Airbus has been considering enhancing the A380 with a package of measures which would include upgraded engines and a short stretch to accommodate another 50-60 seats.

All three Gulf carriers had their A380s on the air show static park, with the Emirates superjumbo (A6-EOP) the first of the carrier’s fleet to be configured in a higher density 615-seat configuration. It was delivered from the airframer’s Hamburg plant on 4 November. ■

SPECIAL MISSIONS

Piaggio unveils Abu Dhabi-backed maritime P180

Piaggio has rolled out the first example of its maritime patrol aircraft (MPA) at its factory near Genoa.

The formal unveiling on 9 November came as the Italian airframer was in Dubai to promote the heftier and heavily modified special mission version of the P180 Avanti, which it has developed in collaboration with Abu Dhabi Autonomous Systems Investments (ADASI).

ADASI will operate the first

two aircraft. To accommodate a higher endurance of 8-9h, the MPA’s maximum take-off weight grows by more than one-third to 7,480kg (16,500lb). The weight increase drove Piaggio to extend the size of the wingspan, canard and tailplane.

Pratt & Whitney Canada replaces a 850shp (634kW) PT6 turboprop engine with a 950shp version, including a five-bladed Hartzell scimitar propeller. In the cockpit, the demonstrator on

display revealed the new layout with the Rockwell Collins Pro Line Fusion avionics suite, replacing the Pro Line 21 system. The MPA version includes an upgraded copy of the touch-screen system developed for the Beechcraft King Air.

The avionics suite is integrated with the Saab-designed mission control system. As targets are identified, the system can alert the flight management system to change the flight plan. ■



Roll-out was on 9 November

PROPULSION

Engine makers ready for A320neo EIS

P&W insists September's problem "resolved" while CFM says Leap-1A certification is imminent and service entry on schedule

As first delivery and service entry nears for the Airbus A320neo to launch customer Qatar Airways – due late this year and early 2016 respectively – the manufacturers of both engine choices for the narrowbody have reiterated their preparedness for airline operations.

"We will be ready," says Pratt & Whitney's commercial president Greg Gernhardt.

The supplier of the PW1100G geared turbofan – which will be on the initial customer aircraft –

has had ups and downs during the certification process.

Most recently, an A320neo flight-test vehicle was grounded in late September due to an unspecified problem found during a hot-weather flight test in Al Ain in the United Arab Emirates.

Asked about the incident, Gernhardt says the issue is "resolved".

He adds: "And all production engines and all compliance engines don't have that issue. So it's an issue that's behind us."

Launched in 2008, P&W's geared turbofan engine has been selected for five aircraft programmes. These applications span three different sizes of the powerplant. The engine family has amassed 24,000h in tests, including 6,400 flight hours, on 84 engines, including 50 that remain active, Gernhardt adds.

CFM International, meanwhile, expects certification for the Leap-1A engine "imminently", ahead of service entry on the Neo next year. All certification

tests are complete and the reports are finished, says François Bastin, executive vice-president of the General Electric-Snecma joint venture. "We've always said we'll enter service at the right time. We'll deliver the performance guaranteed," he says.

The manufacturer has replaced abradable liners in the cores of three Leap-1A flight-test engines deemed insufficient, it disclosed at Dubai. The liners produced "minor effects... we didn't like", he says. ■

MUNITIONS

USA and UK targets for Textron, Thales Fury

Textron Systems and Thales expect to complete testing of their Fury miniature munition in the first quarter of 2016, and are hopeful they can seal the USA or UK as a launch customer.

The companies are funding the development of the 6kg (13lb) glide weapon, which uses semi-active-laser and GPS guidance to strike within 1m (3ft) of a target after launch from an unmanned or manned aircraft.

Export sales will be subject to approval by the US government, but company executives do not foresee any regulatory barriers for partners and allies.

Brian Sinkiewicz, Textron Systems senior vice-president and general manager for weapons and sensors, says it is targeting the first quarter of 2016 to begin demonstrating the product to potential customers.

Textron Systems is additionally working to integrate the glide munition onto the V2 and M2 models of its RQ-7B Shadow unmanned air vehicle. Test flights have already been performed with the weapon installed, it says.

The V2 Shadow has been test flown with two Fury munitions, while the M2 can carry four. ■



The ACJ319 parked on the Dubai static is on sale through 28 East

BUSINESS AVIATION

Charter firm K5 latest in line for re-powered ACJ

K5 Aviation has become the latest operator to select the VIP variant of the Airbus A319neo, with an order for a single aircraft placed at the Dubai air show.

Delivery of the green ACJ319neo is scheduled for the second quarter of 2019. No decision on engine supplier or cabin outfitter has been made.

The German charter operator is already an Airbus Corporate Jets customer, and one of its three ACJ319s was parked on the static display in Dubai.

That particular aircraft is cur-

rently up for sale through agent 28 East, in which K5 is a joint partner alongside charter broker Vertis Aviation.

"The extra range of the ACJ319neo will enable us to offer longer flights and more city pairs," says K5 chief executive Erik Scheidt.

Alpha Star of Saudi Arabia and the UK's Acropolis Aviation have already been confirmed as early ACJ319neo customers.

Neo aircraft are powered by either CFM International Leap-1A or Pratt & Whitney PW1100G engines. ■



Weapon can be launched from manned or unmanned aircraft

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ROTORCRAFT

NorthStar intends to follow MRH with armed Bell 429

Success of heavily modified 407GX prompts similar initiative using medium-twin helicopter

Abu Dhabi-based NorthStar Aviation will work with airframe manufacturer Bell Helicopter to develop an armed variant of the latter's 429 medium twin.

NorthStar has already seen sales success with its Bell 407GX-derived Multi-Role Helicopter (MRH), notably with the United Arab Emirates air force, which operates 30 examples of the light single.

However, Terry Key, vice-president and chief pilot at NorthStar, says some potential operators want the additional capabilities and security two engines provide.

"Some people want a twin, particularly for operations over water, or for the higher altitude and fly-away capability if they lose an engine," he says.

Although the commercial variant is limited to a maximum take-off weight of 3,180kg (7,000lb) in some countries thanks to civil certification under the Part 27 category, any military derivative could operate at a higher take-off weight, of at



Some 30 examples of the upgraded 407 are operated by the UAE

least 3,400kg. Development would take around a year, says Key, dependent on interest.

Bell in 2006 released images of an armed 429 variant, but never progressed the designs. Patrick Moulay, vice-president for global sales and marketing, says he prefers to leave this to "experts" like NorthStar.

In addition, the UAE firm is working to increase the range of munitions available on the 407MRH, including the R-mod-

el of Lockheed Martin's AGM-114 Hellfire air-to-surface missile and Roketsan's Cirit guided rocket. The MRH is already able to deploy an older Hellfire variant, along with Raytheon's Talon laser-guided rocket and AGM-176 Griffin missile.

New sensors, including the FLIR Systems Star Safire 380 and the L-3 Wescam MX-10 and MX-15 electro-optical/infrared camera will be integrated to broaden choice for customers. ■

ROTORCRAFT

525 Relentless flight tests pick up the pace

Bell Helicopter is making continued progress with its developmental 525 Relentless rotorcraft, having now reached its predicted never-to-exceed speed (Vne) of 165kt (305km/h).

In a programme update, Bell says it has validated the helicopter's Vne at altitudes of both 8,000ft and 12,000ft.

Since its first flight in July this year, the aircraft has accumulated over 50h of ground runs and 40h of flight time, up from the respective figures of 46h and 27h in October.

So far, just one prototype of the 9.1t helicopter is flying, with another two test articles due to join the fleet later this year.

Bell increased the backlog for the GE Aviation CT7-powered twin at Dubai – where it also showed its SimCab device to illustrate the type's fly-by-wire controls – with the signature of letters of intent for five helicopters from independent dealer BGS Corporation (2), Petroleum Air Services (2) and Strong Aviation (1).

Of the 525's more than 60 orders, around 30 have come from the Middle East and Africa. ■

ORDERS

Beechcraft closes on Iraqi Wolverine commitment



Baghdad could take an initial six AT-6s from a 24-strong deal

Beechcraft Defense's AT-6 Wolverine might soon have a launch customer, with a letter of offer and acceptance for six light-attack turboprops being prepared for the government of Iraq.

With the US Air Force, Beechcraft will offer Baghdad six aircraft, with further options in increments of six. That offer is likely to be delivered next month.

The US State Department approved a possible deal for up to 24 aircraft in May, and if accepted, Iraq could become the first AT-6 operator.

Beechcraft Defense president

Russ Bartlett says the Iraqi air force operates 16 T-6A trainers, and the AT-6 meets Iraq's combat requirements.

Beechcraft has long been searching for a launch customer, meanwhile producing three examples for development and display at its own expense.

Bartlett says securing a client will also begin the process of military type certification, making it more attractive to foreign buyers. Beechcraft has been eyeing type certification through a new USAF initiative where companies can self-fund the process. ■



Multiple choices
SHOW REPORT P22

MAINTENANCE

Abu Dhabi duo engineer pact on MRO

Investment fund Mubadala and Etihad look at setting up eastern European facility in move towards closer collaboration

Abu Dhabi carrier Etihad Airways and the emirate's investment fund Mubadala are "exploring the feasibility" of a narrowbody maintenance facility in eastern Europe as part of a closer collaboration.

Mubadala says a tentative agreement the two organisations signed at the show covers "a range of contracts with a potential value of \$1 billion over a 10-year period".

Of the potential new facility, the investment fund says "discussions [are] already progressing with concerned parties", indicating that the project might involve existing maintenance providers.

The agreement with Mubadala additionally includes provisions to transfer more work to Swiss maintenance, repair and overhaul subsidiary SR Technics. The Zurich-based MRO provider will become Air Berlin's "preferred

service provider", Mubadala indicates.

Air Berlin, in which Etihad owns a 29% stake, has an in-house maintenance unit. But the loss-making carrier's chief executive Stefan Pichler has said Air Berlin must concentrate on its core airline operations.

Homaid Al Shemmari, chief executive of Mubadala's aerospace and engineering services, says the accord with Eti-

had is "a mutually beneficial strategic agreement that will deepen our partnership".

Mubadala additionally disclosed an intent to pursue with GE Aviation a pact to operate a GENx engine maintenance facility through a new joint venture.

The new facility will be set up at the Nibras Al Ain Aerospace Park. But the parties involved have not disclosed when operations will start. ■

INSTRUCTION

Emirates downsizes to Phenoms and SR22s to launch pilot training school



A fleet of five Embraer Phenom 100E twinjets will be used for the second phase of instruction

Think of Emirates and large widebodies such as the Airbus A380 and Boeing 777 spring to mind, but a key element of the airline's static display at its home air show comprised two smaller aircraft.

Emirates Flight Training Academy – set up by the airline to address its growing need for pilots – on the eve of the show signed a deal for its first aircraft: 22 Cirrus SR22 piston singles and five Embraer Phenom 100Es, with an option to purchase five more of the light jets. An example of each was exhibited at Dubai.

The aircraft, deliveries of which will begin in 2017, will be used by cadet pilots as they train

to become fully-qualified Emirates first officers. The order, says the airline, will for the first time allow students to receive all their training in Dubai. Previously, cadets underwent the majority of their training at a variety of locations overseas.

"Industry forecasts show growth in the need of pilots, par-

"Industry forecasts show growth in the need of pilots particularly over the next few years"

ADEL AL REDHA

Executive vice-president, Emirates

ticularly over the next few years," says Adel Al Redha, Emirates executive vice-president and chief operations officer.

"The Middle East and the Gulf will have the highest demand for pilots to support its expansion and introduction of new aircraft. The Emirates Flight Training Academy is our investment and response to this pressing need."

The academy is under construction at Dubai World Central, where the air show is located, and will have capacity for 500 cadet pilots. The first phase of construction, which includes the ground training facility and a runway, is due for completion next year. ■

PERSONAL FLIGHT

Martin Jetpack takes off as UAE orders 20

Possibly the wildest exhibit at the show was the personal jetpack being displayed by New Zealand firm Martin Aircraft.

It was a Dubai debut that paid dividends, with the manufacturer netting a tentative order for up to 20 units from the United Arab Emirates for emergency services use. Detailed in a memorandum of understanding, the acquisition covers manned and unmanned Martin Jetpacks with simulators, spare parts and training.

Deliveries to the UAE's directorate of civil defence are due to begin in mid-2016. Flight testing is under way in New Zealand using a prototype identical to the one on the company stand.

The jetpack is powered by a V4, two-stroke gasoline engine that generates 200hp (150kW), driving two ducted fans. The system weighs 200kg (441lb). ■



Martin Aircraft's Peter Coker

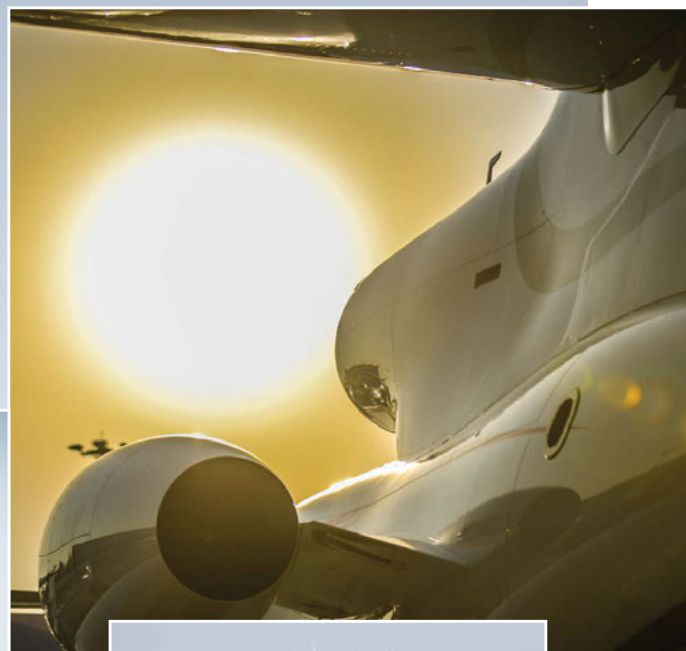
DUBAI 2015

SHOW REPORT



(Clockwise from main) A G450 was among a quartet of Gulfstream types on show, Beechcraft King Air 350ER, Emirates' newest Airbus A380 – with its future Embraer Phenom 100E trainer, the Brazilian company also debuted a new A-29 Super Tucano demonstrator, a Dassault 7X, a US Navy Boeing P-8 takes time off maritime patrol duty, a French air force Airbus A400M, Boeing CH-47F Chinook, Qatar Airways' line-up included a rival 787 and A350, National Airlines 747-400 Freighter





MULTIPLE CHOICES

Highlighting the event's importance for aerospace suppliers across all sectors, the ramp at Dubai World Central played host to some of the industry's finest offerings – from high-end business jets to combat aircraft and transport helicopters

Pictures: BillyPix



DUBAI DELIGHTS

A highly varied display line-up meant there was something for everyone at this year's show; from the latest in advanced fighter technology and widebody airliners to aerobatic teams, first-time visitors and even the occasional classic. And it was clear skies all the way



(Clockwise from main)
Royal Air Force Eurofighter Typhoon, Lockheed Martin F-16E, Dassault's Rafale visited on a sales high – as the United Arab Emirates displayed its Mirage 2000, Sudan's Safat Aviation

Group brought its S02 light helicopter, Airbus flew A350-900 MSN2, the Breitling Wingwalkers, a Pilatus PC-21, Italy's Frecce Tricolori, and a Pakistan Aeronautical Complex Mushshak trainer



INQUIRY DAVID KAMINSKI-MORROW LONDON

Russia divided over 737 operations

Aviation regulator rejects airworthiness body's call to ground type over elevator safety concerns following 2013 Kazan crash

Divisions have emerged at the most senior levels of Russian air transport, after the nation's Interstate Aviation Committee (MAK) unexpectedly attempted to halt Boeing 737 operations over disputed findings in a fatal crash inquiry.

MAK's airworthiness division informed federal aviation regulator Rosaviatsia and the US Federal Aviation Administration on 4 November that it was prepared to withdraw certification approval for the type, claiming unresolved uncertainty about 737 elevators following a Tatarstan Airlines accident in Kazan two years ago.

The decision appeared to catch Rosaviatsia unawares. It insisted that MAK could not halt 737 operations, because its notification needed to be converted into a formal grounding authority on its recommendation.

Rosaviatsia scrambled to convene a meeting with 737 operators on 6 November, to which MAK sent a representative, and subsequently stated that delegates were "unanimous" in their opinion that a suspension was unwarranted. "Operation of the Boeing 737 will continue, on the same basis as before," it states.

Investigations into the Kazan accident have yet to conclude. None of the 50 occupants on the 737-500 survived after it dived

into the ground while attempting a missed approach on 17 November 2013.

MAK says Rosaviatsia had initially signed off the April 2015 draft final report, along with other members of the inquiry team, but withdrew its signature in June. Rosaviatsia had reverted to a previous position, claims MAK, in which it suggested that the 737's elevator control system had contributed to the crash and that the Boeing jet contained a design flaw that demanded modification.

The inquiry, however, had conducted a comprehensive series of tests on the elevator – including borescope and tomography inspection – which revealed no evidence of system failure.

MAK points out that Rosaviatsia, despite declaring its concerns over 737 elevator safety, has not taken steps to restrict the type's operations. This perceived contradiction prompted MAK to seek additional information and then issue its notification on 4 November that it would suspend the airworthiness certificate.

Rosaviatsia, clearly irked by the move, described MAK's actions as "frivolous", and accused the agency of contradicting itself, following the publicity over the certification threat, and hosting "different points of view" within its ranks.



Pobeda and UTair are among national operators of the Boeing type

Alexander Neradko, the head of Rosaviatsia, says the inquiry into the Kazan accident was "not complete", and condemned the leak of information. Unresolved technical matters should remain a subject of discussion by specialists until the investigation is closed, he adds.

MAK has defended its decision to act, saying it was based on Rosaviatsia's own position, and expressed "concern" that Rosaviatsia had apparently kept its thoughts from the crash inquiry to itself for a year-and-a-half and not exercised its authority over a safety matter. It also claims the 6 November decision to allow 737s

to continue operating was taken "behind closed doors", without its involvement.

Boeing says it is "pleased" that Russian authorities have confirmed that the 737 fleet "fully complies" with both US and Russian type certification requirements.

Russian carriers UTair, S7 Airlines affiliate Globus, and Aeroflot Group – which includes Orenair and budget carrier Pobeda – are among the largest operators of 737s in the country.

Many of the jets operated by Russian carriers are registered in external locations, such as Bermuda and Ireland. ■

INTERIORS DAVID KAMINSKI-MORROW LONDON

IAG commonality drive will optimise Iberia A330s

Spanish carrier Iberia is set to take the first Airbus A330 in December to be configured under a common specification for parent company IAG. Introduced on its A320 family, IAG's configuration commonality initiative is being extended to its new long-haul fleet, including A330s and A350s.

Speaking during a capital markets event on 6 November, fleet harmonisation manager Henri



New -200s will have 288 seats

Ozarovsky said the same core principles – lower cost, reduced capital intensity and greater flex-

ibility – are being applied to the long-haul jets.

Ozarovsky says the company is set to achieve cost savings of €3 million (\$3.2 million) for each A330-300, and a weight reduction of more than 1t, by adopting common requirements in the areas of cabin furnishing, avionics and emergency equipment.

Iberia's A330-200s will be fitted with a two-class, 288-seat layout, including 19 seats in the business

cabin. Ozarovsky says the configuration is "extremely flexible", and that once the size of the cabin is set, making efficient use of seating, stowage and cabin attendant seats becomes "much easier".

The A330 standardisation effort has resulted in the removal of an aft temperature-sensitive cargo system, and a redundant third water tank.

IAG's Iberia and Aer Lingus operations each use the A330. ■



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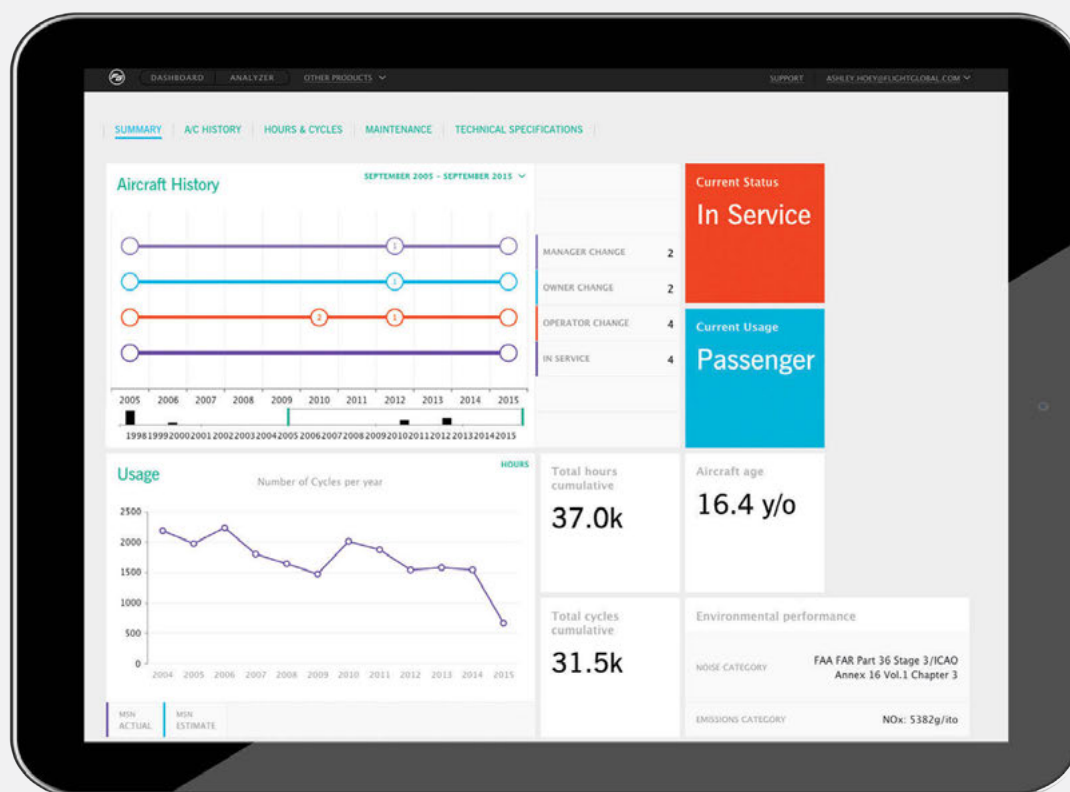


Illustration shows conceptual data only



**Airframer's hopes
soar as MRJ takes
fight to Embraer**
TOP - SUBJECT P30



Type certificate holder BAE Systems has acted to improve clarity over minimum safe speeds in icing

INVESTIGATION DAVID KAMINSKI-MORROW LONDON

Inquiry urges ice awareness

Control incident involving West Atlantic ATP prompts Norway to call for better crew alerting

Norwegian investigators are seeking to improve pilot awareness of an impending stall during icing conditions on British Aerospace ATP turboprops, after a serious incident involving a West Atlantic aircraft last year.

Investigation authority SHT says that ice accretion on the wings can cause the ATP to stall "prematurely", before the stick-shaker activates.

It has advised that ATP crews be made more aware of recommended minimum speeds in icing conditions, and says these thresholds should be "easily available" to pilots in the cockpit.

SHT says that the incident occurred as the aircraft flew north-east of Lillehammer on 25 September last year.

Ice-protection systems on propellers and air intakes were active, and the crew engaged the airframe de-icing system at 15,000ft to remove ice from the wing leading-edge, fin and horizontal stabiliser.

But the ATP's cruising speed bled away – falling by 58kt (107km/h) over 8min, to a minimum of 136kt – and the aircraft began to buffet and shake violently. The flight-data recorder shows that, at one point, the aircraft was rolling 32° while pitched up and descending at over 2,500ft/min. SHT says this "illustrates the seriousness" of the event.

"The first officer, who was at the controls, stated that he had to push the nose down by force," says the inquiry. "The ailerons did not respond properly, and the buffet-

ing was so violent that he could hardly read the instruments."

SHT believes the loss of airspeed was probably due to higher drag on the aircraft as it flew into a region of icing combined with vertical air movement from mountain waves. The aircraft's lowest speed during the incident was 22kt below the recommended minimum speed in icing conditions, but still 16kt above the threshold for stick-shaker activation.

SHT says the aircraft lost around 1,000ft of altitude – although the underlying terrain was not a threat – and the crew regained control after about 30s. BAE Systems, the type certificate-holder for the ATP, has taken steps to improve clarity over minimum speeds in icing, says the inquiry. ■

SAFETY

GREG WALDRON SINGAPORE

Mandarin E190 poorly trimmed for crosswind

Taiwan's Aviation Safety Council (ASC) says that flightcrew, air traffic control (ATC) and airport shortcomings contributed to the 20 September 2014 runway excursion of a Mandarin Airlines Embraer E190 at Taichung.

The regional jet (B-16821) was attempting to land on Taichung's 3,200m (10,500ft) runway 36 when it bounced during touchdown before its main right gear departed from the runway.

During the initial approach, Taipei ATC advised the crew that visibility at Taichung was 2,740m with a thunderstorm overhead. The wind was 5kt (9.2km/h) from 330°. As the crew made its final approach at 21:26 local, the runway visual range had fallen to just 550m, but the Taichung tower failed to alert the E190's crew. The wind had also swung to 280° and increased to 9kt.

As it descended through 50ft, the E190 began to deviate from the runway centreline towards the downwind side. Aircraft data indicates that the crew's crosswind correction was "either insufficient or was in the incorrect direction", says the report.

The bounce on landing contributed to the drift, causing the jet to leave the runway for around 7s, some 2,120m from the threshold.

ASC investigators determined that the aircraft was not trimmed properly for landing in a crosswind and suggest the crew should have executed a go-around. ■

EXPANSION

A319s to fuel growth at 717 stalwart

Volotea is to add four Airbus A319s to a fleet consisting solely of Boeing 717s. The Spanish-headquartered airline says it will start taking the European narrowbodies in February 2016.

It indicates that the A319's range and the 20% extra capacity the aircraft offers were factors in the decision to select the type, as was the fact that sourcing 717s is increasingly difficult.

The A319s are to be based at Nantes, France. Flightglobal's Fleets Analyzer database shows Volotea has 19 717s in service.



AirTeamImages



PROGRAMME MAVIS TOH SINGAPORE

Airframer's hopes soar as MRJ takes fight to Embraer

Debut flight with Mitsubishi Regional Jet is a watershed moment for nation's first passenger aircraft since 1960s

When the MRJ regional jet prototype lifted off from Nagoya airfield early on 11 November, it achieved a long-awaited milestone, and set the stage for an intensive, 18-month flight test campaign.

During this time, Mitsubishi Aircraft must demonstrate the performance claims it has promised of the MRJ. It needs to work especially fast considering that in April, when it pushed the new type's first flight date back until the final quarter of 2015, it stuck with plans to deliver the first example to launch customer All Nippon Airways in the second quarter of 2017.

"We have no concerns about delivering the aircraft in Q2 2017," vice-president of sales and marketing Yugo Fukuhara tells *Flight International*. "The period between first flight and delivery is 1.5 years. This is a range typical of other commercial programmes."

Mitsubishi president Hiro-michi Morimoto says the compa-

ny "will make our utmost efforts towards type certificate acquisition, committing all our resources to develop and produce the finest regional jet."

The company will be using five flight-test aircraft during its 2,500h campaign. The second has completed final assembly, and had its Pratt & Whitney PW1200G engines attached, while aircraft numbers three to five are in the final stages of assembly. Fukuhara says these will join the campaign in intervals of "a few months".

STRENGTH TEST

The Japanese airframer has completed 100% of load tests on its static strength test jet, and the airframe will also be required to demonstrate resistance at ultimate loads of 150% by the middle of next year. Fatigue strength tests will last five years and commence in 2016.

It is critical that Mitsubishi keeps to schedule to maintain its slim lead over its strongest competitor – the Embraer E-Jet E2,



which is due to enter service less than a year after the MRJ90.

Mitsubishi says its clean-sheet design will help it take full advantage of the aircraft's geared turbofan engines, helping to reduce fuel burn, emissions, noise and maintenance costs. Its value proposition is that the MRJ will have a lower operating cost, but also deliver enhanced passenger comfort.

"On paper, the MRJ looks like an efficient competitor in the future regional jet market, delivering performance and economics far better than those of today's incumbents and benchmarking well against future competitors like the E-Jet E2," says Rob Morris, head of Flightglobal's Ascend consultancy. "So achieving performance targets must be a key focus."

DEMAND AARON CHONG DUBAI

Airframer confident of sales into European market after milestone success

Mitsubishi Aircraft is positive about its prospects in the European market, where the MRJ regional jet has yet to secure a firm order.

Speaking at the MRJ stand at the Dubai air show, Yoshihisa Kumagai, president of Mitsubishi Aircraft Corporation Europe, said the company "is in active discussions with several European carriers and is expecting more upcoming interest", but declines to identify prospective airline customers.

Kumagai lists several factors why the company has been unable to break into Europe.

"Many legacy airlines are conservative; they don't dare to take risks with a new, unproven aircraft. Part of the problem also lies with us – in arriving late. Our competitors

were already pushing their products much earlier than us." European carriers also are seeking aircraft types with a minimum capacity above 100 seats, he adds.



Mitsubishi type needs to land deals beyond Asia and the USA

Still, Kumagai is confident of MRJ's portfolio, describing it as "a whole-package solution". The 76- to 80-seat MRJ70 will compete against the Bombardier Q400, while the 88- to 92-seat capacity MRJ90 and 100-seat MRJ100X will go up against the Bombardier CRJ900 and Embraer's E-Jet E2 family aircraft, respectively.

Regarding the planned development of the MRJ100X, Kumagai admits the company's "tables are full".

"We will redirect our resources to the MRJ100X after we have successfully completed the roll-out of the MRJ70 and MRJ90," he adds. ■



An intensive, 18-month test campaign is to follow

Naoyu Otsu/AP/Press Association

To avoid the struggles of inexperienced peers, Mitsubishi has chosen to co-operate in flight test work with Seattle-based Aerospace Testing Engineering & Certification, with this activity scheduled to start in the second quarter of 2016.

The firm specialises in flight testing, data analysis and US Federal Aviation Administration certification services for aircraft manufacturers. As such, Mitsubishi will also be sending four flight-test aircraft to the USA for various tests, including envelope expansion, functional performance, flight characteristics and anti-icing.

Mitsubishi says that while the FAA is conducting a shadow certification of Japan's Civil Aviation Bureau, all necessary information and paperwork for the type certification of the MRJ will also be shared with the US authority concurrently.

The majority of the work on both certifications will be conducted "almost simultaneously", says Fukuhara. He adds that while Japanese certification is likely to be attained a few months

before first delivery, FAA approval should follow within a further three months.

Forecast International's senior aerospace analyst Ray Jaworowski says that while achieving FAA and European Aviation Safety Agency certification is a lengthy and costly process, it is "a necessary prerequisite" for penetrating the large and lucrative markets in North America and Europe.

"A successful first flight will deliver a strong message that the MRJ programme is moving forward"

YUGO FUKUHARA
Vice-president sales, Mitsubishi Aircraft

Mitsubishi has so far secured firm orders for 223 MRJ90s and options and purchase rights for a further 184 aircraft (see graphic, P32), with the largest orders coming from USA's Trans States Holdings and SkyWest. However, both face scope clause limitations, which could force them to

Prototype 'exceeded expectations'

Mitsubishi Aircraft says the operational performance of its MRJ regional jet prototype exceeded expectations during its 87min maiden sortie from Nagoya airport.

The Japanese airframer says the basic characteristics and functionality of the aircraft in ascent, descent and turning were confirmed during the flight, which was conducted in the airspace off the Pacific coast.

"Operational performance of the MRJ was far better than expected. We had a significantly comfortable flight," says chief test pilot Yoshiyuki Yasumura.

Senior executive vice-president Nobuo Kishi also confirms that the flight went as planned.

Painted in the manufacturer's red, black and gold livery, aircraft FTA 1 was flown with its landing gear and flaps in a fixed position and its thrust reverser



AP/Press Association

Chief test pilot Yasumura

system unengaged throughout the flight, during which it climbed to 15,000ft and reached a speed of 150kt (277km/h).

Yasumura says control of the Pratt & Whitney PW1200G-engined aircraft was "very stable", and that the aircraft made an excellent landing, despite slightly windy conditions.

take the smaller MRJ70 if conditions are not relaxed.

The MRJ70 is targeted to enter service a year after the MRJ90. Parts production for the 76-seat variant is already under way, and the plan is to build two flight test examples.

Fukuhara contends that the MRJ90's debut will boost the manufacturer's sales campaign. "A successful first flight will deliver a very strong message that the MRJ programme development is moving forward," he says.

Jaworowski says fulfilling the type's fuel burn and operating cost promises "will be key to attracting significant new sales". He adds that it is also important to establish a global sales and customer support network, which Mitsubishi is already "making great strides in", with the help of Boeing and Saab.

The last time Mitsubishi's order book grew was in January 2015, when Japan Airlines firmed an order for 32 MRJ90s. The manufacturer says that, as it has yet to secure an order from Europe, this will be a focus area. Fukuhara

says it is also in talks with narrowbody and turboprop operators in Asia, and believes that the regional jet has good potential in countries like Australia, India, Indonesia and Vietnam. Additionally, the company is seeing "very strong interest" from lessors, he continues, adding: "I hope in some time after first flight, we can announce some new orders."

LARGER VARIANT

Mitsubishi also needs to decide whether to proceed with the development of a 100-seat variant – something it has been unwilling to commit to – a size the market is moving towards. The company's former president has said that he sees the need for a full range of aircraft to be competitive, but that whether to launch the larger variant remains a business decision.

The MRJ is a major project for Japan, because it is the country's first passenger aircraft since the NAMC YS-11 turboprop entered service in the 1960s.

The Ascend Fleet Forecast predicts deliveries of close to 1,200 MRJs through to 2034. ■



Japan Airlines/J-Air

JAL firmed up order LOIs for 32 MRJ90s in January 2015. First delivery is planned for May 2021, to be operated by domestic feeder J-Air, based in Osaka

Orders  32

ANA – All Nippon Airways

Japan's largest airline placed its orders for 15 MRJ90s and options for a further 10 in March 2008. With first delivery expected in June 2017, it will be the launch operator for the new type

Orders  15
Options  10

Air Mandalay

In April 2015, the Myanmar-based regional airline indicated its "2018 mission" was to expand its fleet with the purchase of up to 10 MRJ90s

Orders  6
Options  4

Mitsubishi MRJ90

PASSENGERS	88 (single class, 31in pitch)
CARGO COMPARTMENT	18.2m ³
ENGINES	Pratt & Whitney PW1217G
MAXIMUM TAKE-OFF WEIGHT	39.6t
MAXIMUM LANDING WEIGHT	38.0t
MAXIMUM ZERO FUEL WEIGHT	36.2t
RANGE (88 PAX x 102kg)	1,150nm

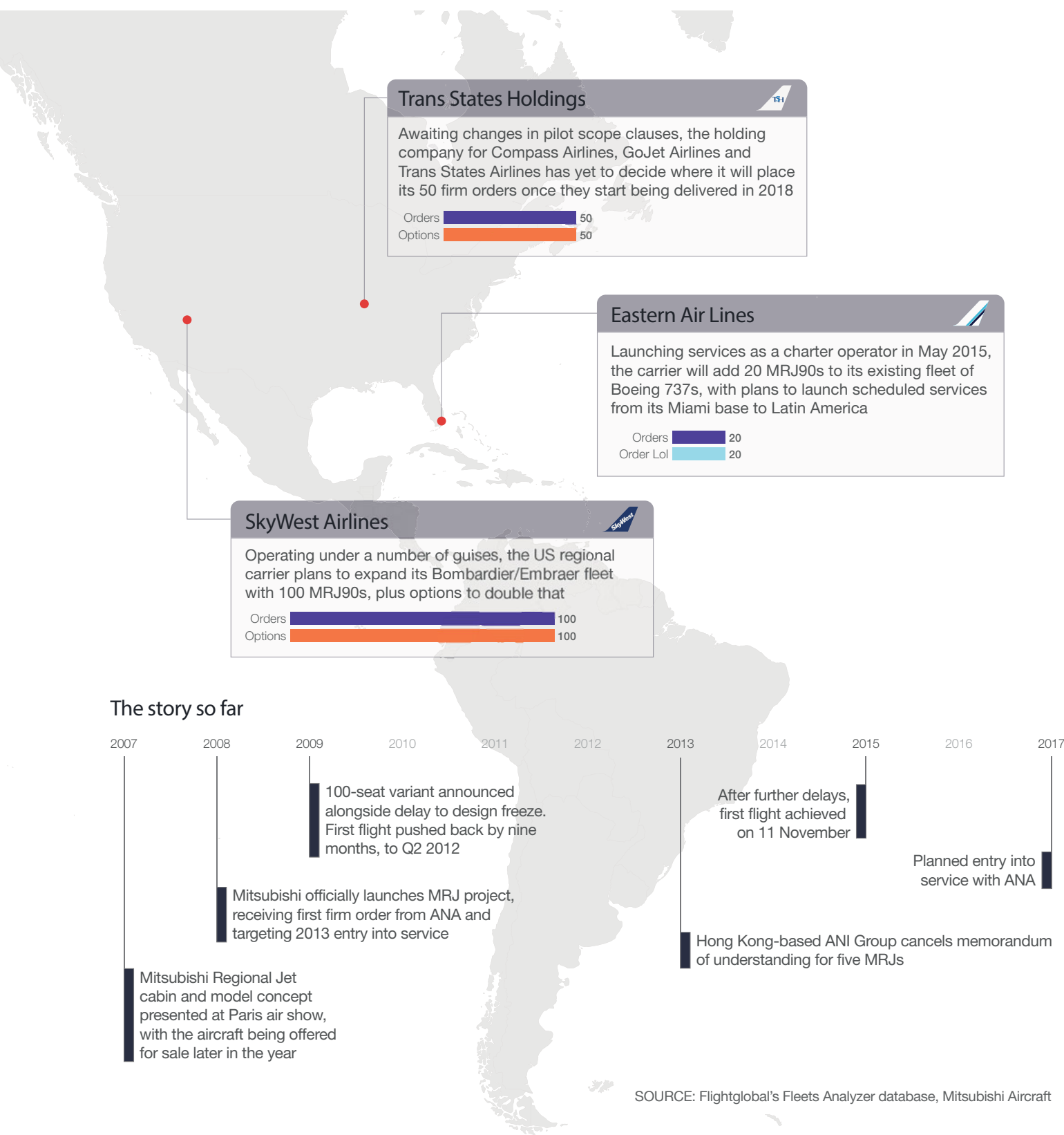


MRJ sales in detail

Conceived in 2007 and formally launched the following year, Mitsubishi's MRJ programme will deliver a Japanese-developed regional jet which is also the nation's first indigenous passenger aircraft to have flown since the NAMC YS-11 turboprop – production of which ended over 40 years ago. With firm orders in place from six customers in Asia and the USA, the 88-seat MRJ90 leads a potentially three-model family, also counting the smaller MRJ70 and a proposed 100-seat variant. With Mitsubishi's most recent contract for the type – a 32-unit deal to equip Japan Airlines feeder J-Air – having been secured in January 2015, the company will be hoping that its 11 November flight debut will encourage additional operators to commit to the design. Our data snapshot outlines the current status of Mitsubishi's orderbook for the in-development type




Gripen NG on track for 2016 first flight
DEFENCE P37



223 Total firm orders for MRJ90

An aerial night view of the Dubai skyline, framed by the large, white, curved arch of the Jumeirah Emirates Towers. The city lights are visible in the background, with a prominent highway interchange and several skyscrapers, including the Burj Khalifa, illuminated. The text "FROM DUBAI TO FARTHER" is in white, and "A BETTER WAY TO FLY." is in yellow.

FROM DUBAI TO FARTHER
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PROTEST JAMES DREW WASHINGTON DC

Losing team attacks LRS-B decision

US Government Accountability Office to review Boeing/Lockheed Martin appeal of USAF selection for \$80bn programme

A Boeing/Lockheed Martin team has asked the US Government Accountability Office (GAO) to review the US Air Force's "fundamentally flawed" selection of Northrop Grumman for the \$80 billion Long-Range Strike Bomber (LRS-B) project.

The protest follows the losing team's debrief on why Northrop was chosen for the development and eventual production of up to 100 low-observable, next-generation bombers, worth an estimated \$564 million per copy.

A protest had been widely expected, even by USAF officials,

regardless of who won, given the value of the contract and industrial impact to the losing side. The development programme alone is estimated to cost \$23.5 billion.

Boeing and Lockheed reportedly tried to underbid Northrop on cost to secure the "strategically im-

portant" bomber contract, and Northrop's selection was seen by some analysts as an upset win. The protest puts the programme on hold for up to 100 days while the GAO reviews the source selection process and decides whether to sustain or deny the protest.

"The cost evaluation performed by the [US] government did not properly reward the contractors' proposals to break the upward-spiralling historical cost curves of defence acquisitions, or properly evaluate the relative or comparative risk of the competitors' ability to perform, as re-

quired by the solicitation," the companies said on 6 November.

"That flawed evaluation led to the selection of Northrop Grumman over the industry-leading team of Boeing and Lockheed Martin, whose proposal offers the government and the warfighter the best possible LRS-B."

In rebuttal, Northrop described the source-selection process as "exceptionally thorough and disciplined" and expressed disappointment that the protest would hold up a programme "so vital to national security". ■

The protest puts the programme on hold while the GAO reviews the source selection process

RETIREMENT

USAF names end date for QF-4 targets

The US Air Force expects to cease carrying out test support using its 22-strong fleet of BAE Systems QF-4 Phantom aerial targets in January 2017, followed by a complete out of service date in the middle of the same year.

The target aircraft – based at Holloman AFB in New Mexico – is being replaced by the Boeing QF-16, the first of which was delivered to Tyndall AFB in Florida in March. Tyndall ceased operating the QF-4 in May 2015, making the 53rd Wing's Detachment 1 82 Aerial Targets Sqn at Holloman the last remaining operator.

The remaining QF-4s will continue to fly manned and unmanned live fire test support for the Department of Defense and Foreign Military Sales customer testing until 31 December 2016, says 1st Lt Amanda Farr, 53rd Wing spokesperson.

The last QF-4s are expected to be destroyed during live fire testing, and any that are not destroyed by 1 January 2017 are likely to be demilitarised, Farr says. ■

DURABILITY JAMES DREW WASHINGTON DC

Fatigue test results to support extra lease of life for ageing F-16 airframes

Lockheed Martin has tested the structural integrity of an F-16C Block 50 over 27,700 equivalent flight hours as it seeks to extend the life of the aircraft from 8,000h to 12,000h.

The company says full-scale stress and fatigue testing at its durability test facility in Fort Worth, Texas, concluded in July after reaching 27,713h over 32 rounds, and the aircraft is now being pulled apart and inspected for structural aberrations.

The extensive testing allows Lockheed engineers to develop a roadmap for keeping Block 40 to Block 52 versions operational beyond their original design life of 8,000h.

The US Air Force plans on life-extending approximately 300 F-16C/Ds after cancelling a more comprehensive modernisation package, since the Lockheed F-35 will come online far later than originally expected. The airframer also is looking to satisfy the structural needs of 27 other F-16 operators, with its current emphasis on Taiwan and South Korea.



More than 27,700h of equivalent flight time was accumulated

The life-extension preparations come as Lockheed also has commenced flight tests of its enhanced F-16V configuration from the Fort Worth site.

The type features Northrop Grumman's APG-83 scalable agile-beam radar and is being offered as a new-build or an upgrade, preferably as an inte-

grated upgrade and life-extension package.

Lockheed is continuing to produce F-16s at a very low rate and recently delivered its final tranche of Egyptian Block 52-model fighters. Four aircraft arrived at Cairo West air base on 29 October and have been immediately integrated into the force. ■



**GAMA data shows
jets on the rise as
props lose power
BUSINESS AVIATION P38**

TESTING BETH STEVENSON LONDON

First release keeps Oslo's JSM on heading for F-35

Kongsberg has carried out an airborne launch test of the Lockheed Martin F-35's future Joint Strike Missile (JSM), in the lead-up to its 2017 qualification target for the weapon.

During the October test the missile was released at 22,000ft over the Utah Test and Training Range from an Edwards AFB, California-based Lockheed F-16. This is the same type that the Royal Norwegian Air Force's F-35As will replace.

The medium-range anti-ship

and land-attack JSM is being developed with Raytheon and the Norwegian defence ministry. It can fit inside the weapons bay of the conventional take-off and landing F-35A, but can also be adapted to other aircraft.

In July 2014 the Norwegian Defence Logistics Organisation awarded Kongsberg a Nkr1.1 billion (\$177 million) Phase III contract to complete the development and integration of JSM on the F-35, ready for the introduction of Norwegian aircraft in 2017. ■



Royal Norwegian Air Force aircraft will deploy Kongsberg weapon

DEVELOPMENT CRAIG HOYLE DUBAI

Gripen NG moves into final assembly

Prototype aircraft 39-8 to make debut flight during 2016, as Saab welcomes first Brazilian engineers to Linköping facility

Saab has lifted the joined fuselage section for its first Gripen NG prototype into final assembly, and says its programme is on track to deliver advanced capability to Sweden and export customer Brazil.

Revealing the advance at the Dubai air show on 10 November, Ulf Nilsson, head of Saab's aeronautics business area, said the fighter's three main sections required only one minor adjustment before they could be joined. "We had less [production line] feedback on the first aircraft than we have on the running production of the [Gripen] C/D," he notes, attributing this to the new model's all-digital design.

Nilsson confirms that lead prototype aircraft 39-8 is on schedule to enter flight-testing during 2016, but will not reveal a target date.

He also highlights the progress



The main sections required a single adjustment before being joined

being made with the manufacturer's Gripen E/F deal with Brazil. A first group of 50 Embraer engineers and their families recently arrived in Linköping, with a total of 300 to spend up to two years in Sweden to build the Brazilian company's design and production expertise on the type. "It's full-speed ahead

— a real long-term partnership," Nilsson says, adding: "They call it a Brazilian aircraft; they are committed to the programme."

With Saab holding contracts to produce 60 new-generation aircraft for Sweden and 36 for Brazil, Nilsson says the company is looking to build on its success. It

is looking with interest at emerging requirements in Finland and Belgium, and also hopes to meet the needs of nations including Bulgaria, Croatia and Slovakia through deals supported by the Swedish government.

Saab already has the Czech Republic and Hungary as Gripen operators in Europe.

Meanwhile, Saab delivered its MS20 operating standard software for the Gripen C/D to its Swedish customer in September, with final flight testing now under way. The enhancement includes the addition of MBDA's Meteor beyond-visual-range air-to-air missile.

Longer-term sales opportunities could also lie with Indonesia, Malaysia, the Philippines and potentially in southern Africa, Nilsson says. However, Saab notes that it is not promoting the aircraft in the Middle East. ■

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ANALYSIS KATE SANSFIELD LONDON

GAMA data shows jets on the rise as props lose power

Delivery data for first nine months of 2015 shows industry fortunes varying, with propeller-powered segment stalling

It was a tale of contrasting fortunes for the business and general aviation industry in the first nine months of 2015. The latest statistics from the General Aviation Manufacturers Association (GAMA) reveal that propeller-driven fixed-wing aircraft fared poorly between January and September, while their business jet counterparts did well compared with the same period a year earlier.

Released on 6 November, the GAMA data shows that total aircraft deliveries fell by 107 units year-on-year, to 1,558. However, the value of those shipments actually rose to \$15.7 billion – \$200 million more than in 2014.

The piston-engined sector was the worst performer between January and September. Tumbling demand for single- and twin-engined types from the international training school and owner-flyer markets resulted in an 11% decline in shipments during this period to 719 aircraft, down from 806 deliveries during the first nine months of 2014. Third-quarter shipments fell by 25 units year-on-year to 255 and by 16 compared with the three months ending 30 June.

With the exception of Cessna, which saw a 34-unit hike in shipments across its piston-engined line between January and Sep-

tember, all the airframers recorded a decline in numbers. Diamond Aircraft disclosed a 50% drop in deliveries of its four-seat DA40 during this period, from 125 to 62, while Germany's Flight Design did not hand over any CT piston singles in the last quarter.

Aerospace analyst Brian Foley attributes the weak performance to what he calls the dominant used aircraft market. "The value equation to this very price-elastic buyer segment still favours pre-owned," he explains.

"Agricultural aircraft were affected by US Export-Import Bank's inability to make new financing guarantees"

PETE BUNCE
President, GAMA

Turboprops fared little better than the piston segment between January and September due to continued weakness in the agricultural sector. Nine-month deliveries of single- and twin-engined models slid by more than 9% year-on-year, to 374 aircraft.

Air Tractor recorded a drop in shipments of its AT family from 121 to 88 this year. Thrush Aircraft also saw its S2R series fall from 28 to 19. GAMA president Pete Bunce blames the fall in demand on the paucity of government finance to support the international purchases.

"Our agricultural aircraft sector has been particularly hard hit by the [credit export agency] US Export-Import Bank's inability to make new financing guarantees since 1 July," Bunce says. He is hopeful that the US government

re-authorise the bank in coming months, which could reinvigorate this niche sector.

If the agricultural segment is excluded, however, the core-business turboprop market has remained stable, GAMA reveals. The top performer between January and September was Quest Aircraft. Thanks to its burgeoning international dealership network, shipments of the Kodiak single-engined model climbed by over 30% to 20 units compared with the same period in 2014.

On a year-on-year basis the business jet sector also improved, climbing 19 units to 465 aircraft in the first nine months.

CORPORATE BUYERS

The latest surge is due to a number of factors: the strengthening US economy, which has precipitated the re-emergence of corporate buyers and high-net-worth individuals; the hike in new aircraft deliveries to the fractional ownership providers such as NetJets and Flexjet; the entry into service of Cessna's midsize Citation Latitude, of which four were handed over between June and September; and the production ramp-up of new light and midsize models including the CJ3+, Embraer Legacy 500 and Bombardier Challenger 350.

With the service entry of a clutch of keenly awaited designs expected before the end of the year – the Legacy 450, HondaJet and Challenger 650 – the industry will be hoping to continue this positive growth trend.

The top-end of the business-jet sector has remained stable during the first nine months, according to GAMA. Despite the continued slump in demand for big, long-distance aircraft from the interna-

tional markets such as China, Brazil and Russia, deliveries of these high-performing types fell by only five aircraft year-on-year, to 172. This excludes shipments of Dassault Falcon twin- and tri-jets, however, as the French airframer does not report third-quarter delivery figures.

MODEST RISE

Gulfstream saw shipments of its top-end trio – the G450, G550 and G650/ER climb by five aircraft to 89 business jets between January and September. Boeing recorded a two-aircraft hike in BBJ shipments, including two BBJ787-9s, while deliveries of Embraer's Legacy 600/650 and Lineage 1000E remained static, at nine.

The association reveals that Bombardier bore the brunt of this segment's modest shipment decline. The Canadian airframer recorded a nine-unit fall in Challenger 605 shipments, to 11 aircraft year-on-year – this is due in part to customers transitioning to the soon-to-enter service Challenger 650. Deliveries of the high-end Global 5000 and 6000 also fell by three units in the same period, to 52 aircraft. Bombardier is now readjusting the Global production rate to reflect the falling sales.

Aviation analyst Rolland Vincent predicts the business-jet sector will end the year with a slightly lower shipment total than 2014. "We forecast 709 single-aisle business jets of all stripes – this will be just below GAMA 2014 totals [of 717]," he says. "This may be a bit conservative, but there is some certification risk with new jets like the HondaJet that drives deliveries into 2016. There are also some white-tails that will need to be sold to complete the year." ■

See Flight Test P42



Bombardier's customers are moving to the Challenger 650

Bombardier

NINE-MONTH BUSINESS AND GENERAL AVIATION DELIVERIES

	2014	2015
Piston	806	719
Turboprop	413	374
Jet	446	465
Total	1,665	1,558
Billings (bn)	\$15.5	\$15.7

SOURCE: General Aviation Manufacturers Association "Excludes Dassault Falcon business jet shipments"



Like flying, virtually
CENSUS P40

RETROFIT BETH STEVENSON LONDON

Glass cockpit for cold Otter

British Antarctic Survey will now verify the DHC-6 upgrade as it waits for further funding

The first of the British Antarctic Survey's (BAS) four de Havilland Canada DHC-6 Twin Otters has undergone a glass cockpit upgrade, with a roll-out to the remainder pending a further funding allocation from the UK government.

The upgrade to a Garmin G950 cockpit was completed by Rocky Mountain Aircraft under the supplemental type certificate (STC) of Aero Corp in October. This will now be incorporated into operations to verify the system.

"The STC is now there for the rest of the fleet, but we just need to get the money from the government to do the rest," Rodney Arnold, head of the air division at BAS, tells *Flight International*.

"There is a financial reason for



British Antarctic Survey

Among other benefits, the upgrade improves situational awareness

doing it because the instruments are so much cheaper, and there is a safety issue because it increases situational awareness and gives a single-crew pilot in a remote, difficult environment a massive advantage."

Arnold says that while the BAS is "very confident in the system", verifying the updated cockpit on one of the turboprops and fixing problems at this stage is preferable to having to do this on all four. ■

PROBE ELLIS TAYLOR SINGAPORE

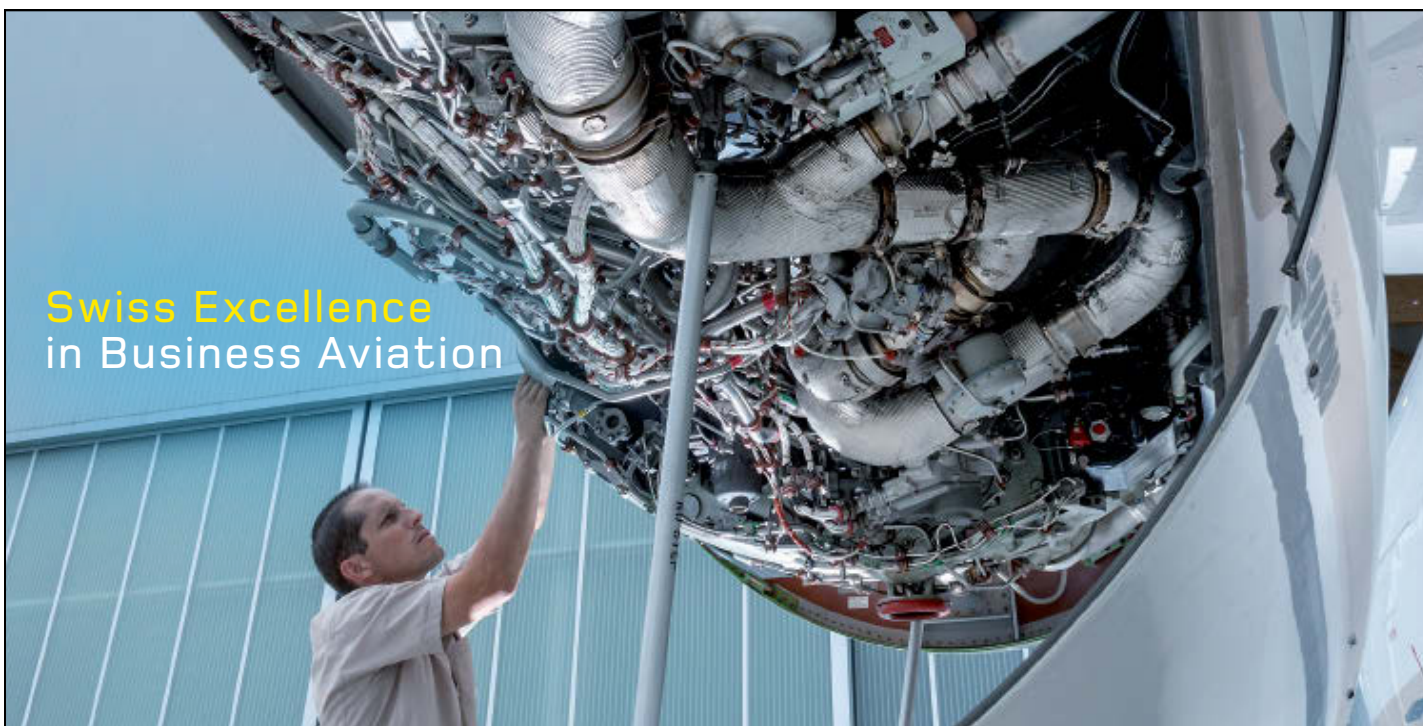
Ditched Pel-Air Westwind will be recovered

The Australian Transport Safety Bureau (ATSB) will raise an Israel Aerospace Industries 1124A Westwind business jet that crashed near Norfolk Island in 2009, as it reopens an investigation which was criticised for not having recovered the aircraft's data recorders.

The ATSB says it has contracted Pacific Maritime Group to assist in the recovery of the aircraft, which was operated by Pel-Air Aviation.

The Westwind was on a medical evacuation charter flight from Apia to Sydney on 18 November 2009 when it ditched into the Pacific Ocean 5km south-west of Norfolk Island. It ran out of fuel while attempting to divert to the island in bad weather. ■

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US Air Force

F-16s worldwide are backed up by more than 230 simulation devices, including 132 of the US Air Force's 603 simulators

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Which aircraft types are best-supported by training on the ground? Which air forces do most to keep aircrews sharp? Our annual Military Simulator Census tells all

ANTOINE FAFARD LONDON

More than 2,200 military aircraft simulation devices are active globally, and 66% of these were supplied by five companies, according to the latest data from Flightglobal.

Canada-based CAE, which leads the civil manufacturer market, also supplies the majority of military devices, commanding 19% of the market. L-3 Link Simulation & Training follows with 18%, while FSI has 11%. Thales and Boeing each have a 9% share, with the remaining 34% of the market supplied by other manufacturers.

Lockheed Martin and Boeing are the aircraft makers whose types are most supported

by simulators, accounting for 22% and 20% respectively of all devices. Rotorcraft manufacturers Sikorsky and Bell Helicopter account for 9% and 5%, while Beechcraft has a share of 8%.

MARKET LEADER

When looking at aircraft types, the data shows that there are more than 230 simulators for the Lockheed F-16, representing more than 10% of all devices.

Simulators for the Beechcraft T-6 Texan II are second in volume, with a 6% share. At 4% each are the Boeing F/A-18 Hornet and Sikorsky's UH-60 Black Hawk and SH-60 Seahawk helicopters.

The Lockheed C-130 Hercules and its C-

130J update account for the majority of the transport/tanker simulators, collectively comprising close to 50% of devices in that sector.

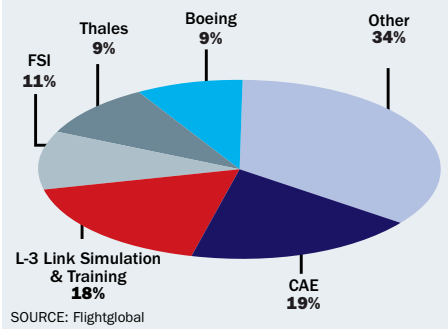
Combat-aircraft simulators account for 35% of the market while helicopter simulators total 31%. Training aircraft, special mission and transports/tankers account for 13%, 12% and 8% respectively. Unmanned air vehicle simulators represent only 1% of military simulators.

The USA is where 55% of the world's military aircraft simulators are based; a total of 1,220 devices. With more than 600 simulators, the US Air Force alone accounts for nearly half of the devices in the USA – and 27% of the world total. The US Navy and US Army have shares of 22% and 19% respectively in the USA. France, the UK, Canada and Australia account for shares of 5%, 4%, 3% and 2%; the entire rest of the world hosts less than a third – 31% – of simulators.

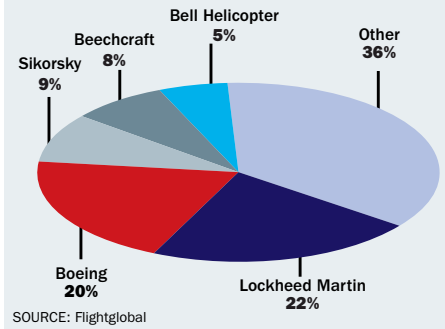
Flight training devices account for 14% of all military simulators, followed by operational flight trainers. Full mission simulators and full flight simulators have a shares of 12% and 11% respectively, while weapon systems trainers account for 6%.

The Military Simulator Census 2015, sponsored by CAE, features a listing of military simulators, including operator and device information by aircraft type and by country. The census can be downloaded for free at flightglobal.com/milisim ■

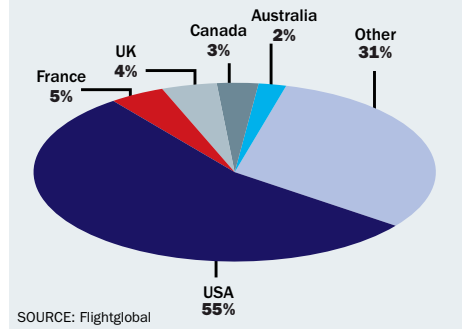
MARKET SHARE BY MILITARY SIMULATOR MANUFACTURER



MILITARY SIMULATOR SHARE BY AIRCRAFT MANUFACTURER



MILITARY SIMULATOR SHARE BY COUNTRY



MILITARY AIRCRAFT SIMULATION IN THE USA

Aircraft category	Number of devices
Combat aircraft	365
Helicopter	363
Training aircraft	181
Transports/Tankers	143
Special mission	142
UAV	26
TOTAL	1,220

SOURCE: Flightglobal

MILITARY AIRCRAFT SIMULATION IN THE USA

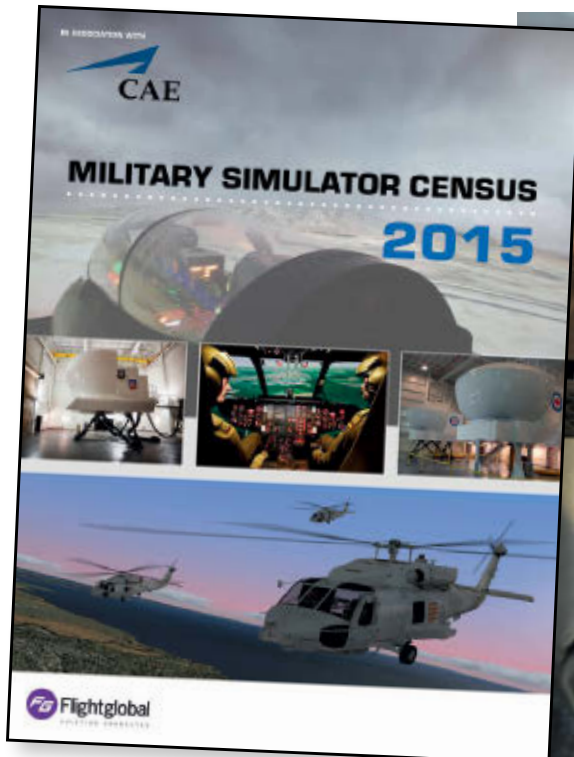
Operator	Number of devices
US Air Force	603
US Navy	268
US Army	229
USN/USMC	67
US Marine Corps	38
Other	15
TOTAL	1,220

SOURCE: Flightglobal

COMBAT AIRCRAFT SIMULATED IN USAF

Aircraft type	Number of devices
F-16	132
F-22	54
F-15	44
B-1	26
F-35	11
Other	8
TOTAL	275

SOURCE: Flightglobal



The military simulators breakdown 2015 – sponsored by CAE – can be downloaded



US Air Force



CAE offers training centres, training services, and simulation products for maritime patrol aircraft.

Download the Military Simulator Census online now.
www.flightglobal.com/milisim



DESIGNING A PERFECT LEGACY

Embraer's latest aircraft completes its Executive Jets portfolio and reflects the airframer's strong focus on delivering ambitious technology at a reasonable price

STEPHEN TRIMBLE SAO JOSÉ DOS CAMPOS

Delivering the first Legacy 450 later this year marks the passage of a remarkable milestone. It means Embraer Executive Jets will not have a new aircraft in development for the first time since 2005, completing an industry-altering decade of product activity. Having laid a seven-aircraft foundation, starting with the Legacy 600 15 years ago, Embraer now plans to build on it.

Before Embraer entered the market, Hawk-

er-branded business jets were still in production. Passenger cabins with flat floors and 1.82m (5.9ft) ceilings were luxuries reserved for market segments above the midsize class. Fly-by-wire technology was available – at a price point above \$50 million.

Then came the Brazilian intervention. Established in 1969 by the Brazilian air force, Embraer had been privatised by 1994 and cemented its future in the regional jet market with the arrival of the E-Jet family in 2004. By then, the company's 4,000 engineers and 2,000 techni-

cians needed a new project. The light and mid-size segments of the business jet market have always attracted entrepreneurs and start-ups promising new technology, but few of these attempts have had the financial backing and engineering clout of Embraer.

So Embraer launched the Phenom 100 and 300 entry-level and light business jets, respectively, in 2005. Two commercial derivatives – the Legacy 650 and Lineage 1000 – followed into production. Then Embraer launched the MSJ and MLJ – midsize and mid-light jets, respectively – in 2008, which became the Legacy 500 and Legacy 450.

Fittingly, the Legacy 450 completes the Embraer Executive Jets portfolio as perhaps the most technologically ambitious of the ensemble. It shares with the larger Legacy 500 the same fly-by-wire control system that electronically activates all of the control surfaces, including two ailerons, two elevators, a rudder and six spoiler panels. But Embraer almost seems to downplay its significance on the Legacy 450 by describing the fly-by-wire system as “unique” in its class.

Apart from a military jet fighter, the Legacy 450 represents the smallest aircraft yet to appear with a fly-by-wire system and a commercial airworthiness certificate. The same technology can be found in other business jets, but only for a much steeper price. When the much larger and longer-range Gulfstream G500 enters service in 2018, it will come with a \$42 million price tag. Embraer sells

The Legacy 450's wings are a compromise between speed and short-field performance





Embraer used its engineering centre in Florida for the Legacy 450 interior design work

the Legacy 450 for a little over \$16 million.

To the aircraft buyer, the benefits of fly-by-wire technology are not always tangible. It is the bump in the air the passenger doesn't feel or the unsafe speed the control surfaces prevent the pilot from commanding. But there are still moments that the digital processing of pilot commands come to life for even the most aerodynamically oblivious passenger. The landing gear lowers, but there is no sudden change in speed or attitude as the fly-by-wire system automatically compensates for the aerodynamic disturbance, for example.

COCKPIT

In the cockpit, however, the pilots are immersed in the fly-by-wire experience, starting with the mechanism used for controlling the aircraft in pitch and roll. Embraer's classic ram horn yokes are replaced by sidestick controllers. With this interface the pilot commands the ailerons and elevators indirectly. By physically manipulating the controller, pilots inform the primary flight control computer of their intentions. Software in the computer translates those inputs into digital messages, which are dispatched to remote electronic units located closer to the control surfaces. These devices send specific instructions to the actuators that move the control surfaces.

By inserting a computer between the pilot and the mechanical systems that activate the motion of ailerons, elevators and rudder, the fly-by-wire system enables new ways of interfacing with the controls, including some that could even seem spooky in a manually-driven flight control system. For instance, the Legacy 450 pilot can push the sidestick forward to command the nose to pitch down. If he simply lets go of the controller, the nose will continue pointing down. The fly-by-wire system will "hold" the pilot's command until a new input is sent to the flight control computer.



Sidesticks have replaced ram horn yokes

It is possible to design such a feature because the fly-by-wire system will not allow the aircraft to point down for so long that the aircraft accelerates beyond a structurally-imposed speed limit.

These flight envelope protections are within

the discretion of the designer. Boeing has designed fly-by-wire systems that leave final authority with the pilot. The Airbus philosophy invests ultimate authority in the computer. There are commands the computer will simply not allow the pilot to perform. The Embraer philosophy effectively splits the difference.

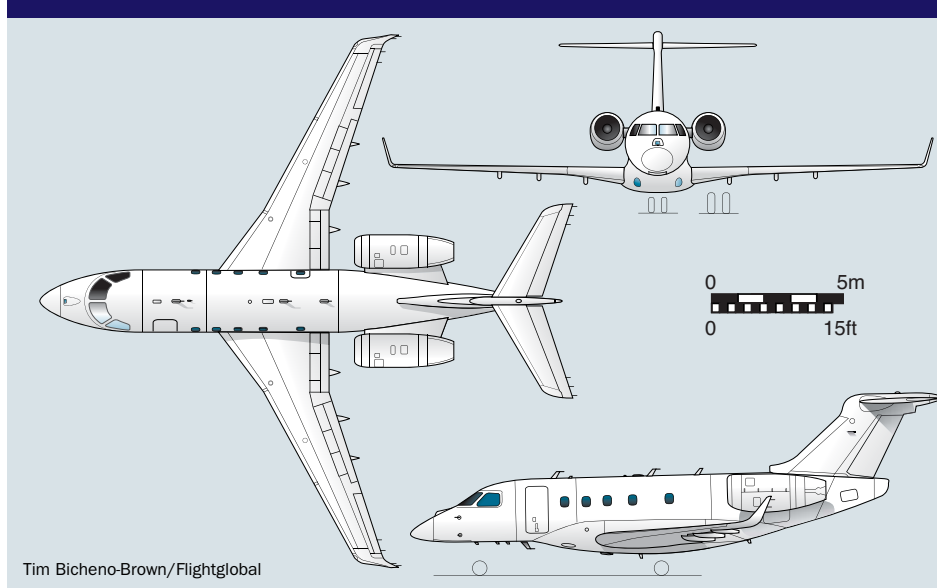
It defines a "normal" flight envelope measured by speed and attitude. The pilot can make any input within the normal flight envelope, and the flight control computer will allow it. If the pilot must go beyond the normal envelope, the computer is programmed to allow the command, but only if the pilot continues sending the same input. The moment the pilot releases the sidestick, the computer will return the aircraft back to the normal flying envelope.

The digital controls of the fly-by-wire system are complemented by Embraer's selection of a cockpit system. The company has proven especially open-minded when it comes to avionics vendors. Honeywell supplies a version of the Primus Epic integrated avionics system for the E-Jet family cockpits. Garmin is the integrated avionics supplier for the Phenom series aircraft. But the Rockwell Collins Pro Line Fusion won the competition for the cockpit of the Legacy 450.

It features four 15.1in displays in a T layout unimpeded by unnecessary ram horn yokes. A terrain database loaded into the cockpit systems allows pilots to see a synthetic image of the world outside the aircraft at night and in any weather.

Like differing philosophies on fly-by-wire controls, avionics companies are also divided on where pilots should look to read instruments. Honeywell prefers a head-down approach for instrument flying, so its cockpit systems display instrument data below the glare shield. Rockwell Collins, by contrast,

EMBRAER LEGACY 450



Tim Bicheno-Brown/Flightglobal

» prefers to keep the pilot looking through the windscreen, so it has developed a line of “head-up” guidance systems.

Aircraft in the size class of the Legacy 450 are especially sensitive to the centre of gravity effects of heavy equipment placed close to the tail or rear of an aircraft. Normal projection equipment, as mounted in the ceiling of the cockpit for head-up display (HUD) systems on much larger aircraft, is too heavy for the Legacy 450. But Collins has developed the HGS-3500 compact HUD for midsize and light business jets.

The compact HUD displays normal guidance on speed, altitude and heading from the flight computer. An upgrade now in flight test will also allow the pilots to use the HUD to “see” through darkness and bad weather. External sensors will feed a composite image of the outside world into the HUD. That image is overlaid onto the graphical display of the terrain database. As regulators become more comfortable with the technology, manufacturers hope such enhanced vision/synthetic vision systems (EVS/SVS) will allow aircraft to fly and land in any kind of weather. Embraer expects to have the EVS capability certificated on the compact HUD as an optional upgrade next year.

NAVIGATION

Embraer also introduced new technology in the navigation system. The most accurate inertial navigation systems using laser-ring gyros are heavy, expensive and need ram air ports for cooling. But Embraer is introducing the Northrop Grumman LITEF APS 4000, a lightweight attitude heading and reference system (AHRS) based on a fibre-optic gyro. It is slightly less accurate than a laser-ring gyro, with a drift rate of 12nm/h. The result is a state-of-the-art AHRS in the Legacy 450, but at a fraction of the price of an internal system.

With two Honeywell HTF7500E turbofan engines, long-range cruise speed for the Legacy 450 is Mach 0.76. Although speed is partly a function of thrust, it is also enabled by the shape of the wing. But herein lies one of the great trade-offs of aerodynamic design. An easy way



In the end, Embraer shied away from a radical BMW Designworks interior concept

Legacy 450 is the smallest certificated civil aircraft yet with fly-by-wire technology

to make an aircraft go faster is to add thrust and reduce the size of the wing, thereby reducing drag. But another key requirement is minimising take-off and landing distance, allowing the aircraft access to more airports. And that requires as much wing area as can be spared.

As with most aerodynamic applications, solution involves compromise. The inboard section of the Legacy 450 wing is swept back sharply at 27°, accommodating the aerodynamicist's pursuit of as much speed as possible. At roughly one-third span, however, the sweep angle is tapered back in the service of take-off and landing performance.

Inside the wing of the Legacy 450 lies a key difference to its larger sister. Embraer designed the mid-sized Legacy 500 to provide a 3,000nm (5,550km) range. Flight testing demonstrated the aircraft is capable of flying a little further – 3,150nm: enough to fly from São Paulo, Brazil to Miami. The Legacy 450 is built to fly just as far; it shares the wing area and potential fuel volume of the Legacy 500. But as a super-light class

jet, Embraer artificially limited the fuel capacity of the Legacy 450 to accommodate a range of 2,575nm. That is enough to fly from São Paulo to the northern tip of South America, but stops short of crossing the Caribbean Sea.

Inspecting the cabin exterior reveals an obvious difference between the two aircraft. The Legacy 500 sports eight cabin windows versus six for the Legacy 450. Although seemingly trivial, window placement actually drove a structural redesign in the centre fuselage of the Legacy 450. To precisely match the seats with the window positions, Embraer adjusted the space between the structural frames on which the fuselage skins are attached laterally.

INTERIOR

Only a decade ago, it was rare to find an aircraft in this size class with a range greater than 2,000nm. As the Legacy 450 and rivals, such as the Cessna Citation Latitude, raise the standard in the category to a minimum of 2,500nm and flights of up to 6h endurance, the emphasis on getting the interior environment right becomes more important.

According to some accounts, Embraer is quietly responsible for revolutionising how business aircraft manufacturers approach interior design. Its decision to hire BMW Designworks to sculpt the interior concept for the Phenom was a proverbial shot across the bow. If new competitors would re-imagine the business jet interior with automotive concepts, the in-house cabinetry departments that have dominated cabin layouts for decades would no longer cut it.

In the beginning, BMW Designworks also was brought in to propose an interior for the Legacy 450 and 500. The *Jetsons*-like result immediately gained attention, winning awards and recognition. But some features raised as many eyebrows as appreciative sighs.

In the end, Embraer decided to take the interior design of the Legacy 500 and 450 back in-house. But by then the company had the services of a new engineering centre in Melbourne, Florida. ■



The centre fuselage structure of the Legacy 450 is a significant redesign of the 500's



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SMOOTH MOVER

Like its sister the 500, Embraer's Legacy 450 is a clean-sheet design employing state-of-the-art technology at a price tag under \$20 million – and with impressive handling

MICHAEL GERZANICS SAO JOSÉ DOS CAMPOS

When *Flight International* was offered a flight in Embraer's Legacy 450, it was with great anticipation that I made the trek to Brazil to see if it handled as well as its specifications intimated.

And, those specifications are impressive. In the cockpit, the overall design philosophy is "quiet and dark". The Rockwell Collins Proline Fusion flightdeck is well arranged, with the instrument panel housing four 15.1in diagonal high-resolution displays; each display can be segmented from full to 1/2 and 1/4 formats. Sidesticks are located on the leather-covered raised outboard consoles. System control panels are on the overhead panel and logically arranged; switches are primarily push buttons, with some rotary knobs.

The centre pedestal was well arranged,

with an integrated control display unit (CDU) for each pilot outboard of the thrust levers. Each CDU had a scratch pad, keyboard and cursor control device.

The 450 and 500 are Embraer's first fully fly-by-wire aircraft. All control surfaces are hydraulically actuated, with the exception of electric flaps and horizontal stabiliser. Three independent hydraulic systems ensure redundancy, with the electrically powered no 3 system primarily for back-up purposes. Pitch control is effected with two independent elevators, while yaw control is via a single rudder. For roll, the 450/500 has an aileron and three multifunction spoilers on each wing.

The fly-by-wire system has two main modes: direct and normal. As the name implies, normal is the primary operational mode with direct mode as a back-up. In direct mode, flight control laws (FCL) in pitch, roll and yaw are "stick to surface", with speed-based gains. In normal

The fly-by-wire controls allowed slower approach speeds and correspondingly shorter landing distances

mode (up and away) the pitch axis FCL are Gamma Dot, pitch rate command. In most instances, a Gamma Dot scheme approximates a G command one. In roll the normal mode FCL are pure roll rate command, while in yaw they are side slip (beta). The normal mode FCL are designed to keep the 450/500 within its "normal" flight envelope (NFE). Embraer defines this as: +30° to -15° pitch angle, speed between 1.13VS and VMO, and less than 33° of bank.

There are a few exceptions to the above normal mode FCL. The pitch laws vary for take-off and approach and landing. On the ground,

The Legacy 450 and 500 are Embraer's first fully fly-by-wire aircraft



Embraer

Published data shows the 450 can climb to 43,000ft at maximum take-off weight, just short of its 45,000ft ceiling

PT-ZIJ. The flight was flown with Eduardo Camelier, chief Legacy test pilot, from Embraer's Gavião Peixoto facility. After settling into the lefthand seat, I adjusted the lefthand armrest so the sidestick fell comfortably to hand. The thrust levers, however, were mounted a bit too low on the centre pedestal for my liking.

Camelier guided me through the pre-flight preparations, using a paper checklist to confirm pre-start flows were accomplished. Starting the FADEC-controlled engines was fast and easy. Post-start checks were also easily accomplished. A slight bump in thrust was all that was needed to start the 450 rolling. Because of limited cockpit space, Embraer elected to forego a tiller, the steer-by-wire nose-wheel controlled with rudder pedals. At speeds up to 10kt (19km/h), $\pm 62^\circ$ of deflection is available, with authority decreasing as speed increases. We entered RWY02 at mid-field and taxied to the approach end, where a tight 180° turn to line up took less than 10m of lateral offset to accomplish.

Flaps "2" take-off (TO) reference speeds for the 13,633kg (30,100lb) with six occupants and 2,550kg of fuel) Legacy were V1/VR 113KIAS and V2 120KIAS. Once cleared by air traffic control, I released the brakes and advanced the thrust levers. About half way up the quadrant the auto-throttle (AT) engaged and moved the thrust levers to TO thrust of 87.4%N1. The nose-wheel steering (NWS) allowed me to track centreline as we briskly accelerated down the runway. When Camelier called "rotate", about 5kg of aft sidestick was needed to set a TO attitude of 10° . Once airborne, Camelier raised the landing gear, and retracted the flaps as we climbed through 400ft AGL. During acceleration and clean-up sidestick forces in pitch were zero once the initial climb attitude was set.

CRISP ROLLS

Published data shows the 450 can climb directly to 43,000ft at maximum take-off weight, just short of its 45,000ft ceiling. As preview flight time was limited, we elected to stop our climb at 35,000ft. Test day restrictions prevented accurate climb data collection, but Embraer lists a time to climb of less than 11min and fuel burn as 300kg for our configuration. During the climb, I did perform a number of bank-to-bank turns at bank angles of up to 60° , at speeds from 250 to 280KIAS. The Legacy's roll flight control laws (FCL) are roll rate command when airborne. Commanded

rate is proportional to sidestick displacement, with commanded rate ramping up to its maximum of $30^\circ/s$ approaching full displacement. This increase felt natural and gave the 450 a very responsive feel. At all times I was able to capture desired angles of bank (AoB) with little effort. The banks were performed with my feet on the floor, the FCL zeroing out any sideslip. During the climb, I also saw the roll axis bank limitation logic. If the sidestick is released with less than 33° AoB, current bank angle is maintained. At greater than this, it will roll back to and hold 33° , exhibiting positive spiral stability. While similar to Airbus fly-by-wire control logic, the Legacy can still do a complete 360° roll.

During the climb, I was also able to exercise the FMS. I found the CCD made navigation inside each display quite easy, handy for accessing menus and graphical flight planning. I was intuitively able to cue up and execute several Direct To legs, all on the multifunction display's »

EMBRAER LEGACY 450 AND 500

	Legacy 450	Legacy 500
Accommodation		
Crew	2	2
Passengers (typ/max)	7/9	8/12
Dimensions		
Wingspan	20.25m	20.25m
Length	19.68m	20.74m
Height	6.43m	6.44m
Passenger cabin		
Length ¹	5.32m	7.50m
Width	2.08m	2.08m
Height	1.83m	1.83m
Weights		
MTOW	16,000kg	17,200kg
MLW	14,750kg	15,480kg
Std basic op wt ²	10,400kg	10,631kg
Engines		
	2 x Honeywell HTF7500E	2 x Honeywell HTF7500E
Thrust	6,540lb to 18°C	7,036lb to 18°C
Stowage		
Exterior (tailcone)	3.11m ³	3.11m ³
Internal	1.13m ³	1.27m ³
Performance		
Take-off distance ³	1,166m	1,245m
Ceiling	45,000ft	45,000ft
MMO	0.83M	0.83M
Range ⁴	4,769km	5,788km
Landing distance ⁵	741m	773m

NOTES: ¹ including lav, excluding aft baggage area; ² unusable fuel and oil, two crew, std avionics and interior; ³ MTOW, SL, ISA; ⁴ four pax, LRC, NBAA IFR; ⁵ MLW, SL, ISA SOURCE: Embraer

normal mode roll laws revert to direct mode. Flight outside the NFE is allowed, with a number of envelope protection schemes installed: in pitch, angle of attack (AoA) limiter, high speed protection, load factor limiter and low speed functions; in roll, bank limitations; and, in yaw, beta limiter and thrust asymmetry transient reducer. During my preview I would test nearly all of these protection schemes.

The 450 received certification from the Agência Nacional de Aviação Civil (ANAC) in Brazil and the US Federal Aviation Administration (FAA) in August 2015, about a year after the 500. Thrust from the Honeywell HTF7500E was up from planned, giving the 450 and 500 better take-off field performance. Better-than-planned aerodynamics, along with increased horsepower, pushed up high-speed cruise performance, while delivering longer than promised legs. The fly-by-wire controls allowed slower approach speeds and correspondingly shorter landing distances.

COCKPIT FAMILIARISATION

Prior to my flight, I spent some time with Captain Luis Fernando C Berto, familiarising myself with the flightdeck. Berto guided me through flight management system (FMS) initialisation and pre-flight flows. He also showed me the electronic checklist and digital approach charts, which make the 450 a paperless aircraft. My flight was in the first prototype 450, registration

» (MFD) map display. Once level at 35,000ft I disconnected the AT and manually held Mach 0.772, long-range cruise speed. For test day conditions of ISA+10°C, a total fuel flow of 850kg/h held 261KIAS with a resulting true airspeed of 454kt.

Next I set maximum continuous power, 85.3% N1. The Legacy accelerated to and held M0.816 while indicating 278kt. True airspeed was 482kt with 1,030kg/h total fuel flow. Observed test day data on an ISA+10°C day was better than Embraer's published data.

ENVELOPE PROTECTIONS

The Legacy has many safety-enhancing envelope protection features. Most of these are resident in the pitch axis, offering protections at high and low speeds. The first is an attitude protection scheme that activates at pitch angles of +30° and -15°. This is not like the Airbus fly-by-wire scheme with absolute limits; rather it makes exceeding them more difficult. Outside the NFE in pitch, the Legacy's FCL feedback pitch attitude to move it back into the NFE. Release of the sidestick outside the NFE will cause pitch attitude to return to and stabilise at the appropriate limit. At high speeds an over-speed mode allows flight past VMO/MMO (320kt/M0.83), but will prevent dive speed VD/MD (360kt/M0.90) being exceeded.

After completing the work at 35,000ft, we descended at 300KIAS to a medium altitude block of 15,000-18,000ft. Passing 24,000ft I lowered the nose further and allowed the 450 to accelerate to 320KIAS. While ignoring the "overspeed" warning, further acceleration to 326KIAS activated the protection mode, raising the nose. With this safety feature it would be difficult to inadvertently overspeed the 450. With the overspeed protection mode triggered, there is also a bank angle limiter. Slowing below 320KIAS, I rolled the Legacy into a 45° bank and lowered the nose. Passing 326KIAS, AoB was automatically reduced to



The Legacy has a raft of safety features, including an attitude protection scheme

Even at high angles of attack the role response was precise with no yaw oscillations

33°, even with full lateral sidestick input. At high speeds, centering the sidestick will allow the Legacy to roll wings level.

With high-speed manoeuvring complete, we descended to 21,000ft for a wind-up turn to see if the NZ (G) maximum feature of the FCL would prevent an over-g. With power set at 280KIAS I rolled into 60° AoB descent. Increased aft sidestick held a constant speed as g load, displayed on a flight test gauge, increased to and stabilised at 2.5g. Even full aft sidestick would not increase the g loading. During a further descent to 15,000ft we looked at dual sidestick input logic and warnings. Sidestick inputs are summed; equal and opposite inputs yield a "null" input to the flight controls. Inputs in the same direction

are also added, with maximum that of a single sidestick input. Simultaneous displacement triggers an aural warning, as well as a tactile one. With wings level, Camelier and I both put in opposite full deflection roll commands. While I did hear the aural warning, it was the vibrating sidestick that alerted me to the dual input. A sidestick priority button allows one pilot to take command in a dual input state.

Once level at 15,000ft, we investigated the low-speed protection schemes. The first one activates at 1.13VS. If the autopilot (AP) is engaged, the AT will engage and advance power to keep airspeed above 1.13VS. In manual flight, the pitch FCL have positive speed stability. As the aircraft slows, the nose drops, requiring increased aft sidestick to maintain level flight. In normal mode with the AP off (gear down and flaps full), I slowed the Legacy from 130KIAS at 1kt/s. At about 100KIAS I noticed increased sidestick back pressure was needed to maintain level flight.

Full aft sidestick slowed the Legacy to 89KIAS, where we settled into a stable, wings level descent. The FCL's AoA limiter was doing its job, not letting the aircraft slow below approximately 1.04VS. While still holding full aft sidestick, I rolled the Legacy into a 30° lefthand bank. Airspeed increased to 94KIAS, but the wings remained rock steady as our sink rate increased. Next, while still holding full aft sidestick, I put a full right roll input. The Legacy crisply reversed direction and I captured 30° of right bank. Even at these elevated AoAs the Legacy's roll response was precise, with no yaw oscillations. The final low-speed event was an investigation of the AoA anticipation feature; designed to prevent rating through the AoA limit. While still fully configured at 120KIAS and 30° AoB, a full aft snatch of the sidestick generated a good initial pitch rate, slowing as we approached the limiting AoA. Once the FCL determined we were not going to rate through the limit, the pitch rate increased.



Passengers will appreciate the quiet stand-up cabin

LEGACY 450/500 VERSUS KEY RIVALS

	Cessna Latitude	Legacy 450	Cessna Sovereign+	Legacy 500	Challenger 350
Price (\$ million)	16.3	16.6	17.9	20	26.7
Take-off distance*	1,118m	1,166m	1,076m	1,245m	1,474m
NBAA IFR RANGE**	4,908km (full fuel, 454kg payload)	4,769km (4 pax)	5,904km (4 pax)	5,788km (4 pax)	5,926km (8 pax @ 102kg) @M0.80
High-speed cruise	M0.77	M0.82	M0.80	M0.82	M0.82
Landing distance*	817m	741m	792m	773m	826m
Cabin width	1.95m	2.08m	1.68m	2.08m	2.19m
Cabin height	1.83m	1.83m	1.73m	1.83m	1.85m
Cabin length	6.63m	5.32m (WO baggage area) 7.31m (W)	7.71m	7.5m (WO baggage area) 8.37m (W)	7.68m
Max passengers	9	9	12	12	9 (std)
Thrust to weight	0.384	0.371	0.395	0.371	0.361
Wing loading	277.3kg/m ²	356.3kg/m ²	277.0kg/m ²	383.1kg/m ²	379.9kg/m ²

NOTE: *SL STD DAY MTOW **at LRC Speed

SOURCE: Manufacturers

The AoA anticipation scheme and limiter allowed me to manoeuvre the Legacy aggressively at slow speeds, a great capability to have for controlled flight into terrain (CFIT) avoidance and windshear recovery.

ENGINE OUT

Up to that point my evaluation had concentrated on the pitch and roll axis handling qualities of the Legacy. Adverse yaw when rolling and Dutch Roll oscillations in a conventional aircraft show that roll and yaw axes are coupled. For the most part, however, the Legacy's are uncoupled. In the clean configuration, the FCL did a fine job of countering adverse yaw and dampening out any Dutch Roll oscillations.

Next, I would see how the Legacy responded when deliberately exercising the yaw axis. The first exercise was in a gear down and flaps full configuration at 110KIAS. In normal mode, I gradually input full left pedal (rudder). With the sidestick free, the Legacy gently rolled to and maintained an 8° AoB to the left with a like amount of sideslip, demonstrating conventional roll due to yaw characteristics. Holding the wings level with lateral sidestick allowed up to 12° of beta to develop, showing the Legacy could be sideslipped like a conventional aircraft.

The next manoeuvres were designed to highlight how the Legacy would respond to an engine failure. These were done with the gear up and flaps 2. To show that the 450 was at its core a conventional aircraft, Camelier put the 450's flight controls into direct mode. Power was set to 88%N1 (take-off power) on both engines and a climb established. With my hands and feet off the controls, Camelier rapidly retarded the right thrust lever to idle. Just like a conventional aircraft, the Legacy yawed to the right and started an unabated right roll. After rolling wings level, the flight controls were restored to their normal mode. The Legacy has a thrust asymmetry transient reduction scheme, designed to aid pilot recog-

nition of an engine failure. With power set to 88%N1, Camelier again pulled the right thrust lever to idle. The FADEC sensed the thrust asymmetry and reduced the amount of allowed sideslip. This time, the right wing dropped less than 5°, with only 2° of sideslip. Like an Airbus, to improve climb performance, the Legacy's primary flight display (PFD) slip indicator depicts an optimum sideslip angle. By allowing some sideslip there is less cross control and less performance degradation. The 450's benign response to an engine loss gives the pilot ample time to respond, while optimum beta guidance improves climb performance.

TCS FOR LANDING

With increasing automation, one of the few times a pilot may hand-fly the aircraft is in the landing pattern. After finishing the area work, we turned towards Gavião Peixoto for recovery. At altitude I had found the Legacy's handling qualities quite pleasant, allowing for crisp predictable control throughout its speed envelope. While I expected to find the same in the landing pattern, there were differences in the pitch FCL that piqued my interest. With the gear down and flaps 3 or full (landing configuration), artificial speed stability is added to the pitch rate command scheme. A trim control speed (TCS) is set when landing configuration is entered. Sidestick deflection still commands

pitch rate, but there is no auto trim to maintain pitch attitude. Back-up pitch trim switches are mounted on the pedestal for use in direct mode and for setting take-off trim. To relieve forces, a sidestick-mounted TCS thumb switch resets the trim reference speed (TRS), which is displayed as a green arrow on the airspeed tape.

The Boeing 777 also has apparent speed stability, but with yoke trim switches to set TRS. While TRS is not shown to the 777 pilot, I did anticipate flying the Legacy on final approach would also be an intuitive task.

We did two touch-and-go approaches to RWY02, the first with flaps "3" and the second flaps full. The pitch FCL changed to TCS when the flaps were extended to "3" at 150KIAS, on straight-in final. Slowing to the target speed of 118KIAS required constant aft sidestick pressure, periodically relieved by depressing the TCS switch. Once "on speed" I hit the TCS switch one last time, and flew the approach with a fixed TRS. Target speed deviations were easily recognised as sidestick pressure was needed to maintain the desired aim point. While I did jockey the thrust levers a good bit on final, the FCL compensated for the varying pitch forces caused by the high-mounted engines. When "30" (30ft radar altitude [RA]) was announced, I retarded both thrust levers to idle and started the flare. With TRS set at 118KIAS, less than 5kg of aft sidestick pressure was needed to capture and maintain the touchdown attitude. The Legacy settled nicely on the runway, the trailing-link main landing gear ensuring a soft touchdown. The pitch FCL exited the TCS mode and entered their de-rotation mode. In that mode neutral sidestick lowers the Legacy's nose-wheel to the runway at a 2°/s rate. It worked fine, the de-rotation feeling as normal as any I had done in a number of other aircraft.

While rolling down the runway I advanced the thrust levers and Camelier set the flaps to "2" in preparation for the "go" part of the touch and go. At 118KIAS Camelier called



Instruments include high-resolution displays

» “rotate”, the Legacy leaping off the runway at our light weight. A visual circuit was flown, with our final flap setting of full set on the base to final turn. On final I slowed the Legacy to our target speed of 108KIAS and set the TRS there. Other than a lower pitch attitude on final and slightly lower flare attitude, this approach was like the prior flaps “3” one; touch and go with flaps set to “2” and thrust levers advanced, we climbed off the runway for another visual circuit.

I had started to feel quite comfortable with the Legacy, but Camelier would soon up the ante. Shortly after the gear was retracted, he retarded the left thrust lever to idle, simulating an engine failure. Initially I countered the slight yawing motion with right pedal, and levelled the wings. Once stable, I used the PFD’s beta cue to fine tune rudder deflection. Less than 20kg of pedal force was needed to keep the beta cue centred for the climb to pattern altitude, where the engine out exercise was terminated. While it took me by surprise, as had been the case at altitude, the Legacy’s response was as gentle as a kitten.

LONDON CALLING

My third approach in the 450 was a visual steep approach to RWY02, simulating one into London City airport. The approach there has a 5.5° descent path. The 450 has a dedicated steep approach mode, and an amber “steep” is presented in the PFD when armed. Extending the flaps to full engages the mode, steep now green. In the steep mode the spoilers are deployed to a dynamic mid position as determined by estimated aircraft weight. With gear down and flaps full I flew towards the runway at 1,500ft AGL, and started a descent at about 2.2nm from the threshold. Camelier had set -5.5° reference line in the PFD, and once pointed at the aim point (normal TDZ) the aircraft nicely settled into a 5.5° descent path. Target speed was 114KIAS (VREF+10kt) in this instance. The FADEC-controlled engines allowed me to stay on speed, while the flight control synoptic showed about 1/2 MFS extension. I pushed the nose over to increase airspeed, and the MFS extended further to slow



Embraer claims the 450 is cheaper to run and is faster than its rival the Cessna Latitude

LEGACY 450, 500: CERTIFICATION GOALS VERSUS ACTUAL

	450		500	
	Goal	Certified	Goal	Certified
IFR range*	4,630km	4,769km	5,566km	5,788km
Take-off distance	1,219m	1,166m	1,402m	1,245m
High-speed cruise	459KTAS	463KTAS	460KTAS	466KTAS
Landing distance*	701m	635m	732m	647m

NOTE: *4 passengers SOURCE: Embraer

the descent. Pulling the nose up caused the spoilers to retract slightly. Next I levelled the aircraft to intercept and track a 7.5° descent path. The spoilers were nearly fully extended, but the 450 was rock steady as it tracked the off-condition steep path at 114KIAS.

At about 500ft AGL I recaptured the 5.5° descent path and concentrated on airspeed and aim point. I started the round out when “50” (50ft RA) was announced, retarding the thrust levers to idle at 20ft RA. The flare and touchdown were unremarkable, in that it was nicely paced with no ground rush. As with prior landings, the landing gear ensured a smooth touchdown. Once on the ground, the steep mode was automatically exited.

After a routine take-off and climb to downwind, Camelier put the 450’s flight controls into the direct mode by depressing a guarded pedestal push button. This approach would be flown with back-up FCL to a full stop landing. I was prepared for the worst; hoping it wouldn’t be like a “dampers off” approach in a General Dynamics F-111, which can be likened to flying a bowl of jelly. In actuality the 450 now flew like a conventional aircraft. As the aircraft slowed, I used the back-up trim switches to “trim off” sidestick forces, changes in power requiring changes in pitch trim. With flaps full, a target speed of 114KIAS was held on final. In this mode there is a yaw damper, which did a good job of damping out gust-induced oscillations. But it was not as smooth as the normal mode approaches. Reducing power at 30ft RA caused the nose to rise, helping initiate the flare. After a soft touchdown, the spoilers extended and the auto brakes engaged. At 20kt I disengaged the

auto brakes and turned off the runway for the short taxi to the ramp. Shutdown and post flight procedures were easily accomplished.

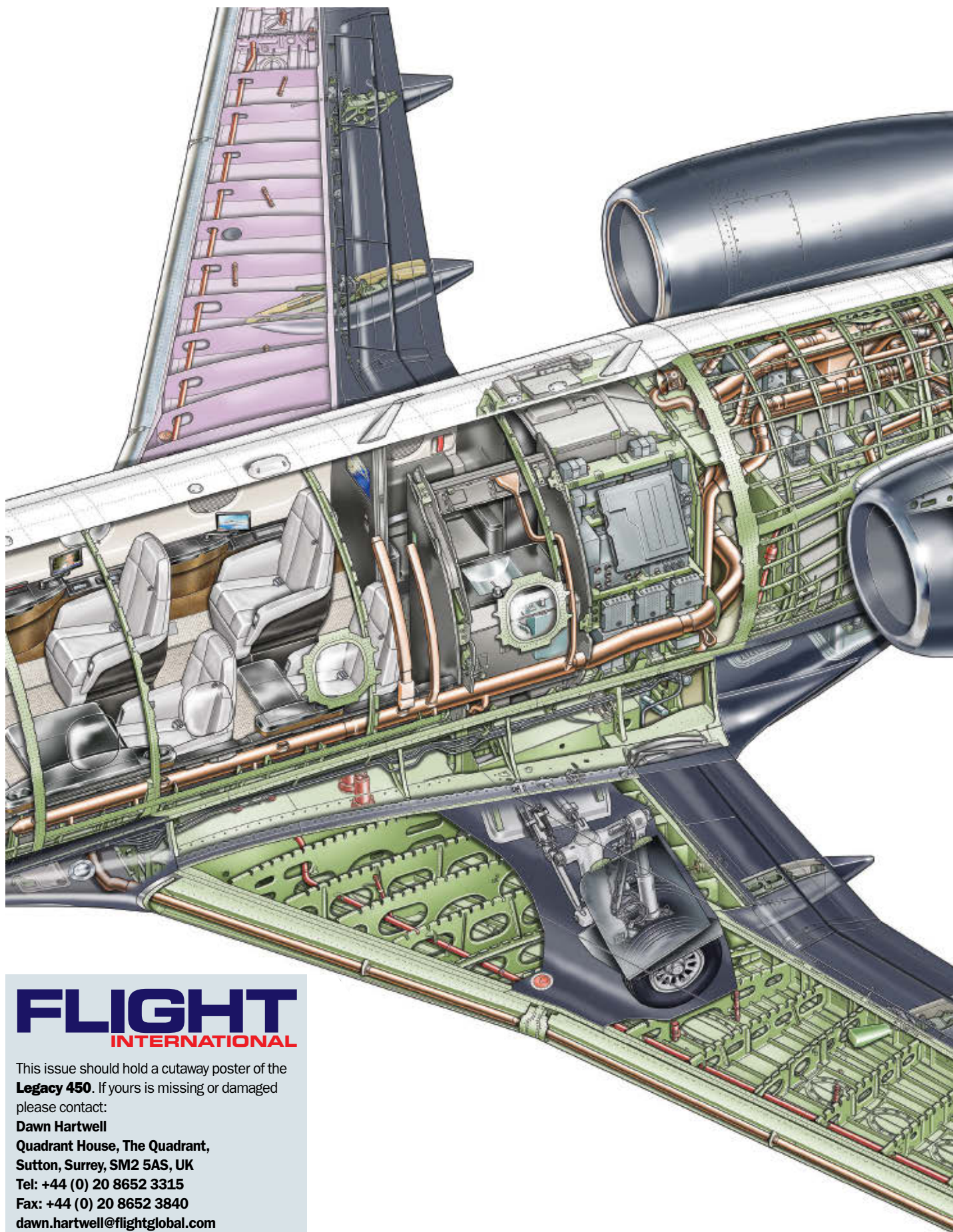
GOOD FEELINGS

The Cessna Latitude was the last mid-light jet I had flown prior to the Legacy 450. Both aircraft fit neatly into that segment with differing strengths. The Latitude costs less and goes further. The 450 costs a bit more and goes a good bit faster. According to Embraer the 450 has lower direct operating costs, and its faster cruise speed means it is even more economical to operate than the Latitude. While the Latitude is a very capable aircraft, from this pilot’s perspective the differences are generational. The Latitude is a Sovereign with a larger diameter (and shorter) fuselage, an aircraft designed over a decade ago.

The Legacy 450 and 500 are clean-sheet designs employing state-of-the-art technology. Embraer is by no means the first to field a fly-by-wire business jet, but it is the first to do so for less than \$20 million. During my 2h flight I was able to push the jet to the edges of its envelope and see first-hand how its numerous safety-enhancing features allowed for true care-free handling. Throughout the envelope its fly-by-wire control scheme gave precise predictable responses to pilot inputs. I found its sidestick had a good feel to it – aircraft responses were proportional to stick deflections/forces. I also liked the auto-throttle and back-driven thrust levers. Owners will appreciate the 450’s low direct operating costs, passengers the quiet stand-up cabin, and pilots the crisp, care-free handling qualities of this paradigm-shifting fly-by-wire business jet. ■



Gerzanic (left), with Eduardo Camelier



FLIGHT INTERNATIONAL

This issue should hold a cutaway poster of the **Legacy 450**. If yours is missing or damaged please contact:

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From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

They came to look, not Dubai

With the biggest news story a commitment for a handful of Airbus narrowbodies from a smaller Vietnamese airline, this year's Dubai air show may have thrown up fewer headlines than its predecessor's multi-billion-dollar orders bonanza. But it gave us plenty of material for this page at least.

For instance, Russian fighters – a popular attraction at any air show – were a notable absence from the static or flying display this year. “It’s not a problem,” one Moscow-based press man quietly reassured us. “We’ve decided to showcase them elsewhere in the region.”

We noted that on Sunday, the first day of Dubai, Airbus had orders for 16 A350-800s, 596 A350-900s and 175 A350-1000s – bringing the total for the XWB widebody family to, you’ve guessed it, 787.

Meanwhile, a persistent Tannoy announcement for an upcoming seminar kept interrupting John Leahy as he tried to present the company’s opening press conference.

The name of the seminar: “Disruption in aerospace”.

Remarked Toulouse’s top salesman wryly: “I want to go and see that.”

Hive of activity

The latest buzz from India is that a SpiceJet flight from Kangra was delayed for more than one and a half hours after a swarm of bees surrounded the aircraft before entering one of the engines.

Perhaps it was overdue a bee check.



“Remember when it was just the two of us, darling?”



We suspect this air show model might be of a MALE UAV

Yuckspeak #193

Thanks to Tom Sheppard for suggesting a much simpler translation for this tongue-tangling piece of Pentajargon from Air Force Secretary Deborah Lee James:

“[LRS-B will operate in] tomorrow’s high-end, anti-access, aerial-denial threat environment”. = High, fast.

It’s all relative

Our recent picture story about “families” of aircraft, as denoted by their registrations, prompted Bob Millichap to send in this picture of Cessna 152s at Tauranga airport in New Zealand. This is definitely an extended family.

Brisbane West Wellcamp Airport, near the Queensland town of Toowoomba, will see its first intentional flight later this month when a Cathay Pacific Boeing 747-800F freighter lands from Hong Kong. The one-off flight will mark the first time Cathay has operated a cargo service into an Australian regional centre and will carry Darling Downs produce to Hong Kong.

A sense of purpose

Lost-ralians

Our thanks to our former colleague Emma Kelly for this misprint from *The Australian*. Presumably, she says, all other flights have been landing at Brisbane Wellcamp – the country’s newest airport – by accident.

Wind up

“Aside from iconic civil types such as Concorde, the magazine also looks at memorable military jets such as the Harrier and Hurricane...” reads a promotion on [another] aviation web site.

Hitler wouldn’t have known what hit him.

Success squad

“One of our flying squadrons, under the most adverse conditions imaginable, and in the teeth of a tempestuous wind, renewed the incursion on the enemy’s aviation camp at Alceizza, on which over 100 bombs were again dropped. Our machines returned unharmed to our lines.”

Sir Charles Craven

On resuming his post as managing director and chairman of Vickers-Armstrongs, Ltd., Sir Charles Craven

has tendered his resignation from the Air Council to the Secretary of State for Air, who has accepted it with regret. Sir Charles Craven has been an additional member of the Air Council since April, 1940.

Spirit of the times

Mr Roy Jenkins, Minister of Aviation, says that the writing-off of BOAC’s accumulated deficit will free the airline from “the incubus of the past.” According to the Oxford dictionary incubus means “an evil spirit, supposed to descend on sleeping persons.”

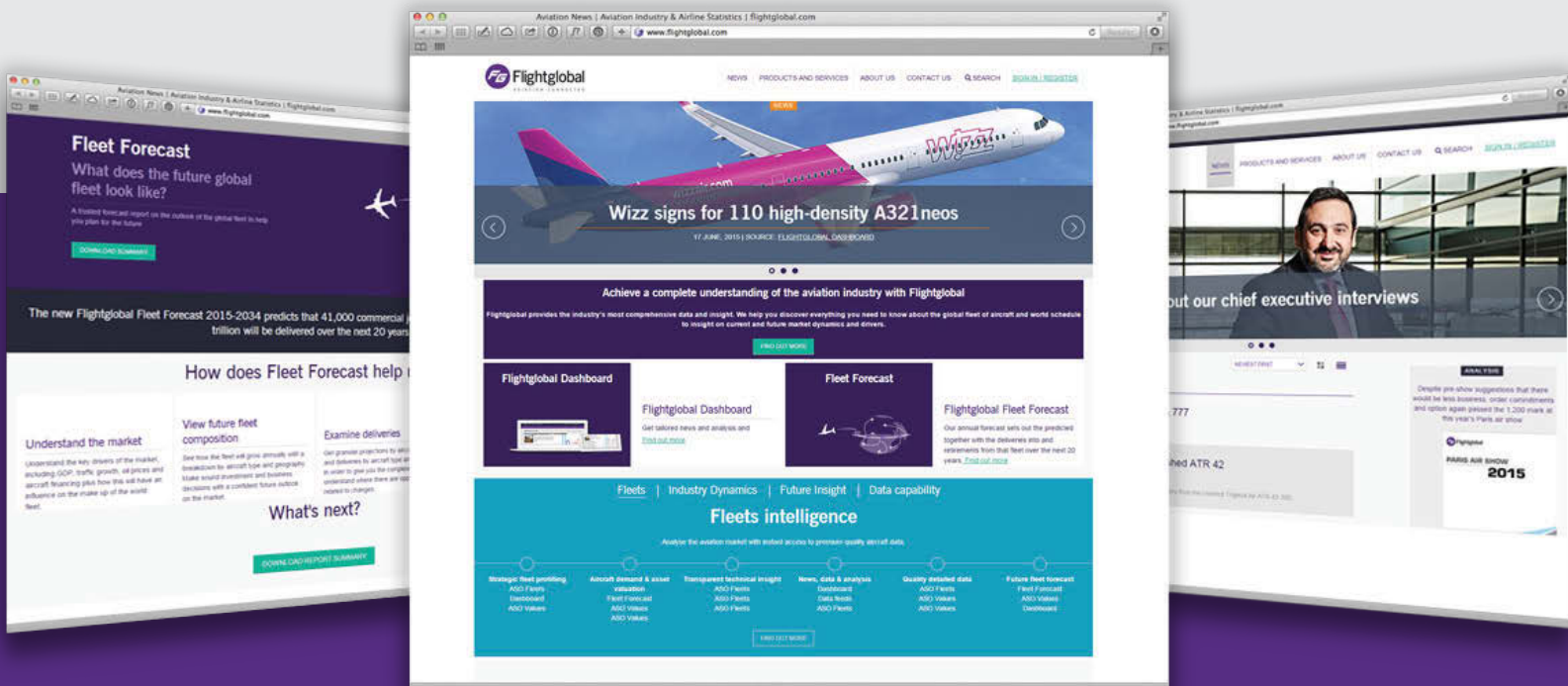
The hot topic

I am writing with regard to an article ‘Thermal imager will beat crime’. Several police forces have been using imaging equipment. Sussex, West Midlands and Strathclyde have used the Computing Devices FLIR 2000 for airborne search and surveillance.

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Registered at the Post Office as a newspaper.
Published by Reed Business Information Ltd, Quadrant
House, The Quadrant, Sutton, Surrey SM2 5AS, UK.
Tel: +44 20 8652 3500.

Newstrade distributed by Marketforce (UK), 2nd Floor,
5 Churchill Place, Canary Wharf, London, E14 5HU, UK.
Tel: +44 20 3787 9001.

Classified advertising prepress by CCM.
Printed in Great Britain by William Gibbons and Sons Ltd.

Flight International published weekly 49 issues per year.
Periodicals postage paid at Rahway, NJ. Postmaster send
changes to Reed Business Information, c/o Mercury
International Ltd, 365 Blair Road, Avenel, NJ 07001

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ISSN 0015-3710 (Print) ISSN 2059-3864 (Online)

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EVENTS

30 November - 2 December

Expodefensa
Bogota, Colombia
expodefensa.com.co

1-2 December

Military Airlift & Rapid Reaction Ops
Seville, Spain
smi-online.co.uk/defence/europe

8-10 December

Aerospace Meetings Brazil
Sao Paulo, Brazil
brazil.aerospace.com/brazil

21-23 January 2016

Bahrain International Airshow
Bahrain
bahraininternationalairshow.com

3-4 February 2016

Aircraft Interiors Middle East
Dubai World Trade Centre, UAE
aime.aero/welcome-to-aime-2016

16-21 February 2016

Singapore Air Show
Changi Exhibition Centre, Singapore
singaporeairshow.com

17-19 February 2016

Routes Americas
Puerto Rico
routesonline.com/events/178/
routes-americas-2016

1-3 March 2016

Heli-Expo
Louisville, Kentucky, USA
heliexpo.rotor.org

6-8 March 2016

Routes Asia
Manila, Philippines
routesonline.com/events/180/
routes-asia-2016

15-17 March 2016

IATA World Cargo Symposium
Berlin, Germany
iata.org/events/wcs/pages/index.aspx

22-23 March 2016

Aerial Firefighting International
Sacramento, California, USA
tangentialink.com/event/aerial-
firefighting-international-2016

26 March - 3 April 2016

FIDAE
Santiago, Chile
fidae.cl/en

5-7 April 2016

Aircraft Interiors
Hamburg, Germany
aircraftinteriorexpo.com

12-14 April 2016

ABACE
Shanghai, China
abace.aero

18-21 April 2016

Defence Services Asia
Kuala Lumpur, Malaysia
dsaexhibition.com

2-5 May 2016

Xponential
New Orleans, USA
xponential.org

24-26 May 2016

EBACE
Geneva, Switzerland
ebace.aero



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Mr Dag Jayasuriya

Senior Manager Technical Contracts

Oman Air, P O Box 58 – Muscat International Airport

PC 111, Sultanate of Oman

Telephone: +968 24519614

E-mail: Dag.Jayasuriya@omanair.com

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General Manager Supply Chain Management

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Marshall



Air Traffic Engineer

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The ATE will maintain all airport communications, navigation and surveillance equipment.

Qualifications Required

- Level 3 ONC/BTEC would be an advantage however consideration will be given to those with relevant experience.
- CAA PTC Group and Type Ratings in compliance with CAP 670 would be an advantage although consideration will be given to those with relevant experience.

Experience

Recent engineering experience in an Air Traffic Control environment at civil airports is essential.

Up to £41,000 per annum

Air Traffic Controllers

As part of the ongoing development of the Airport we require experienced Air Traffic Controllers holding ADI, APP and APS ratings. A Met observer qualification and OJT1 endorsement are desirable but not essential.

Candidates are required to hold a Current EU/UK Driving license and a Current European Class 3 ATCO medical certificate.

Experience of providing ATC services in class G airspace is desirable.

Experience of Safety Management System processes is desirable.

Candidates are required to undertake shift work, including weekends; they must have excellent communication skills, a flexible approach, and must have the ability to operate safely and effectively both on their own initiative and as part of a small and friendly team.

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The interview is scheduled to take place in London in early December and we shall notify those who are shortlisted.

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- Proven experience in the industry
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- Preferably licensed EASA Part 66 B (with type rating), or C licence, or an engineering degree, previous Post Holder experience desirable.
- Detailed working knowledge on regulations, i.e. EU-OPS, Part M, Part 145

To apply quote #DD- Technical Services Manager

Senior Quality Engineers

Qualifications

- Proven experience in the industry
- Proven working experience in a quality system (145 or Ops environment) and preferably with a certifying engineer background
- EASA Part 66 B1 or B2
- Formal training on audit techniques and experience in auditing
- Good working knowledge on regulations, i.e. EU-OPS, Part M, Part 145

To apply quote #CC-Senio Quality Engineers

Safety and Environment Manager

Qualifications

- Has advanced qualification in Health and Safety holding for example NEBOSH with CMIOSH
- Proven experience in air and ground safety issues ideally with an aircraft operator
- Extensive knowledge of legislations such as EU Ops and ICAO standards for SMS
- The implementation of ERP, delivery of safety related training
- A high degree of cultural awareness

To apply quote #BB- Safety and Environment Manager

Helicopter engineers

Qualifications

- Proven experience in the industry
- Proven experience as a certifying engineer, preferably on a current Sikorsky product
- EASA Part 66 B1-3
- Knowledge of EASA and UK CAA regulations

To apply quote #AA-Helicopter Engineers

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Alan Cook is owner and chief executive of Manassas, Virginia-based Metropolitan Aviation, the largest private jet management and charter company based in the US mid-Atlantic region, with a fleet of 10 business aircraft

How did your career in aviation begin?

I started working in the construction business when I was 12 years old, got involved with drag racing and learned how to be an auto mechanic. My sister's boyfriend was a flight instructor and when his car needed to be repaired, I fixed his car in exchange for a ride in his airplane. I had never been out of the state of Virginia, and so I decided to learn how to fly. I was 21 years old and used my birthday money to get my private licence in a Piper Warrior. I went on to get my commercial, instrument, multi-engine, and ATP licences, in addition to about a dozen type ratings for various models of the Gulfstream, Falcon, Challenger, Learjet and the Westwind. Today, I have about 19,000h flight time and I pilot Metropolitan trips as often as my schedule permits.

How did you get involved with Metropolitan Aviation?

While for years I continued my construction business locally and in Florida, I built my time in the Beech Baron and Piper Navajo flying a lot of charter trips. My first full-time contract was flying and managing a Falcon 900. After 9/11 I moved to Manassas, Virginia and started a Part 135 operation. I was able to buy two FBOs at Manassas airport, a 2.4 hectare (6.0 acre) tract and hung up my shingle. Today, I manage the entire operation with the support of an excellent and professional team.



Cook argues that managing costs is the main challenge for charterers

What do you enjoy about your job?

I love meeting all of our clients, which include government officials, movie stars, musicians and business executives. On one day, I sent off five flights including then-prime minister Tony Blair, vice-president Dick Cheney, US House of Representatives Minority Leader Nancy Pelosi, the Queen of Jordan and house speaker John Boehner! Because of our close location to Washington DC, we handle a large volume of government agency trips for the FBI, CIA and De-

partment of Homeland Security.

We have the largest fleet in the mid-Atlantic, including turboprop, light, medium and heavy corporate jets. We pride ourselves on being a locally-owned, private company. This allows us to match the right aircraft size with each of our clients' needs for a particular trip.

We do everything here at our Manassas facility, including booking trips, managing client services and taking care of their assets. With a full-time maintenance department on site, we can handle most items except maintenance

requiring special tooling. We also hire our own flight crews – operating every flight with two captains – and a trained flight attendant.

What's your biggest challenge?

Managing the operation's hard costs – I believe this is the top challenge for every charter operator. The operator incurs the hard costs affiliated with private jet charter, while ensuring a high level of service is provided to the clients.

What has been the highlight of your career to date?

Being able to cultivate a community of aviators here at Metropolitan and have the support of an enthusiastic team around me has been a very important milestone in the history of my company.

What do you see as the biggest trends in business aviation operations in the future?

Fractional ownership is a thing of the past. While brokers are an important part of the business, they are not being regulated or directly invested in operating charter aircraft. This allows them to cause some damage to the industry. All you need to be a charter broker is a cell phone and an email address. We need to protect clients' private aviation travel funds. ■



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